# Instruments

THE MAGAZINE OF MEASUREMENT
INSPECTION · TESTING · CONTROL

*cluding the*

**JOURNAL OF THE INSTRUMENT SOCIETY OF AMERICA** (Page 1725)

*d the*

**JOURNAL OF THE SOUTHERN CALIFORNIA METER ASSOCIATION** (Page 1743)

*this issue . . .*

- River Pollution
- Butterfly Control Valves
- Ultrasonic Inspection
- Steel Plant Training and Maintenance
- Electronic Recorders
- Kinegraphic Control Board
- Putting Instrument To Work
- Improved Flow Control
- 107 New Instruments
- 102 New Bulletins

ol. 25 No. 12
ECEMBER • 1952

OHIO STATE
UNIVERSITY
DEC 23 1952
LIBRARY

**Radiation Counter Laboratories uses a Leak Detector of Consolidated Engineering Corp. to test their Boron Trifluoride Neutron Counters before filling.** ***(Story on page 1634.)***

W

S

D

ASSURE YOU DELIVERY

*Where you want it!*

*When you want it!*

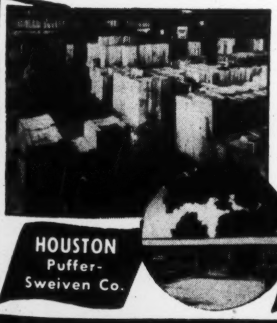
You are *always* close to a source of supply of Fisher *control valves, gas regulators, liquid level controllers* and *pressure regulators.*

Whether your problem is one of existing equipment—or an entirely new control application—the Fisher country-wide network of *19 strategically located field stocks* and *51 representatives*—with over *200 Fisher Service Engineers*—offers you *immediate* and *convenient* service on all your control requirements.

A few typical Fisher Warehouse Stocks of new equipment and replacement parts are shown below.

**FISHER GOVERNOR COMPANY • MARSHALLTOWN, IOWA**

WORLD LEADER IN RESEARCH FOR BETTER PRESSURE AND LIQUID LEVEL CONTROL


HOUSTON
Puffer-Sweiven Co.

NEW ORLEANS
John H. Carter Co.

DALLAS
Vinson Supply Co.

**DIAPHRAGM CONTROL VALVES • PUMP GOVERNORS**
**LEVER AND FLOAT VALVES**

**FISHER**
**SERVICE DIRECTORY**

**ATLANTA**
Rittelmeyer & Co., Inc.
* **AMARILLO**
Vinson Supply Company
**BALTIMORE**
Rhodes Controls Co.
**BIRMINGHAM**
Jos. W. Eshelman & Co., Inc.
**BISMARCK**
Lignite Combustion Engineering Corp.
* **BOSTON**
Wickersham, Petty & Co.
**BUFFALO**
W. J. Sommers Co.
* **CALGARY**
Barber Engineering & Supply Co.
**CHARLOTTE**
Robert E. Mason & Co.
**CHICAGO**
General Meters & Controls Co.
**CINCINNATI**
Harry T. Porter Co.
* **CLEVELAND**
A. E. Ehrke & Co.
* **CORPUS CHRISTI**
Puffer-Sweiven Co.
* **DALLAS**
Vinson Supply Co.
* **DENVER**
Joy & Cox, Inc.
**DETROIT**
DuBois-Webb Co.
**EDMONTON**
Barber Engineering & Supply Co.
**HONOLULU**
H. S. Gray Co.
* **HOUSTON**
Puffer-Sweiven Co.
**INDIANAPOLIS**
Acme Engineering Agency
**LITTLE ROCK**
Johnson & Scott
**KANSAS CITY, MO.**
The Sullivan Mears Co.
* **LOS ANGELES**
Carter-Jones Company
**LOUISVILLE**
Allan K. Cook Co.
**MARSHALLTOWN**
R. S. Stover Co.
**MEMPHIS**
Johnson & Scott
**MILWAUKEE**
Steam Plant Equipment Co.
**MINNEAPOLIS**
Bell & Eiss Inc.
* **MONTREAL**
C. W. Lachapelle, Ltd.
**MUSKEGON**
DuBois-Webb Co.
**NARBERTH, PA.**
Clifford B. Ives & Co.
**NASHVILLE**
Johnson and Scott
* **NEW ORLEANS**
John H. Carter Co.
* **NEW YORK**
Malcolm W. Black and Co., Inc.
**OKLAHOMA CITY**
Vinson Supply Co.
* **ODESSA, TEXAS**
Vinson Supply Co.
**PHOENIX**
W. K. Cone Company
**PITTSBURGH**
W. A. Stoeltzing
* **PORTLAND, ORE.**
Richard H. Brown & Co.
**RICHMOND**
W. H. Kidd & Co.
**SALT LAKE CITY**
Williams, Gritton & Wilde
**ROCHESTER, N. Y.**
Ralph C. Schwarz
* **SAN FRANCISCO**
George R. Friederich & Co.
**SAN JUAN**
F. A. Ortiz & Co.
* **SEATTLE**
Barrett & Yost
* **SHREVEPORT**
John H. Carter Co.
**SNYDER, TEXAS**
Vinson Supply Co.
**ST. LOUIS**
H. D. Hale & Co.
* **TORONTO**
George W. Beecroft & Co., Ltd.
* **TULSA**
Vinson Supply Co.
* **WICHITA**
The Sullivan Mears Co.

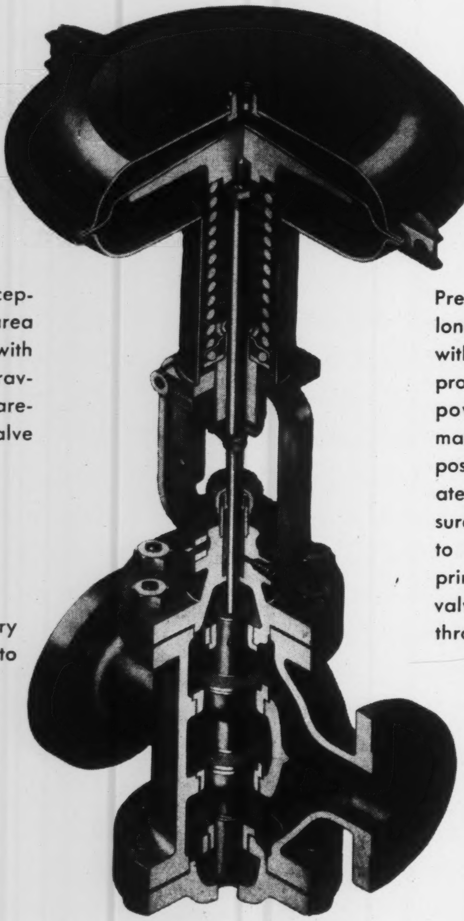
* *Indicates Field Stocks.*

# MADE FOR INSTRUMENT MEN

K & M Automatic Control Valves are made especially to carry out the orders of instrument men. They are *not* merely valves "adapted" to the requirements of modern instrumentation . . . but are *explicitly designed and constructed* to operate precisely and faithfully with instrument direction.

There is a K & M valve for every control valve requirement. Whether you are improving an old process or developing a complex and exacting new one, you can specify K & M valves with confidence.

*An experienced K & M representative is near you . . . eager to discuss your problems. May we put him in touch with you?*



Molded diaphragm has exceptionally large effective area and maintains full contact with diaphragm button at all travels. The full benefit of carefully-engineered inner valve characteristic is assured.

Precisely - calibrated heavy, long-travel spring combines with the large diaphragm to provide exceptionally high power-factor. Friction is made negligible, inner valve positioning extremely accurate. High capacity is assured. Pressure drop is held to a minimum and occurs principally through the inner valve where it is controllable through the full valve travel.

Rugged construction in every detail enables K & M valves to stand up in hard service.

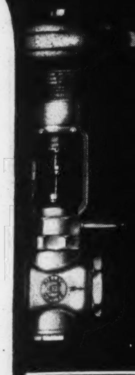
K & M Inner Valves available in a wide variety of designs to provide desired flow characteristics.

**K&M**

**KIELEY & MUELLER, INC.**

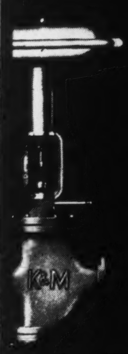
***Valve Makers Since 1879***

**2021-43rd Street North Bergen, New Jersey**

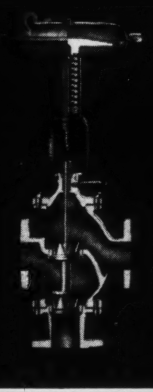


## K&M Series 1000

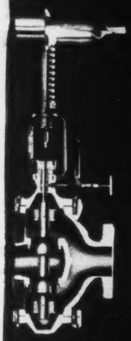
## K&M Series 1550



## K&M Series 1200

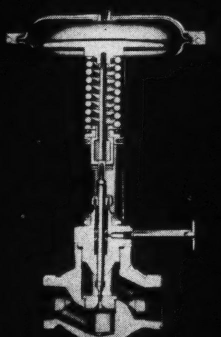


## K&M Series 1700



## K&M Series 1400

Designed for service which requires wide proportional band [illegible] action with separate [illegible] guided inner valve. It can [illegible] in globe or angle pattern, with [illegible] screwed, welding, or [illegible] flanged end connections. Body and trim materials same as series 1200.

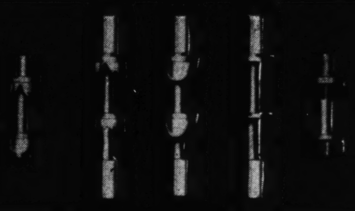


## K&M Series 1850

[illegible]

## K&M Series 1460

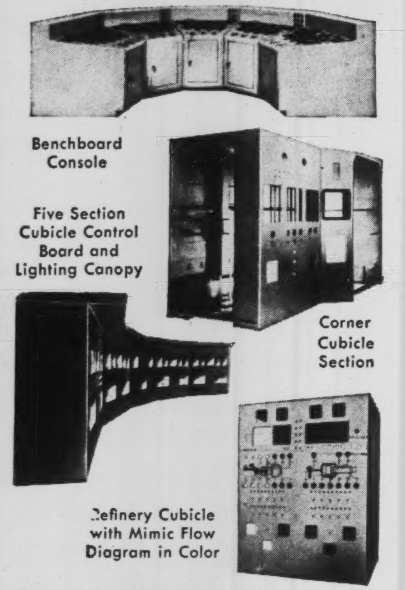
A sweep flow angle valve designed for applications handling and flashing liquids, high pressure drops, erosive, [illegible] or slurry conditions. [illegible] angle pattern [illegible]



## K & M Control Valves

Quality is assured with
**FALSTROM**

INSTRUMENT PANELS
and CONTROL BOARDS


Benchboard Console
Five Section Cubicle Control Board and Lighting Canopy
Corner Cubicle Section
Refinery Cubicle with Mimic Flow Diagram in Color

Superior Engineering MAKES
FALSTROM YOUR LOGICAL CHOICE!

Experienced designing and quality fabrication assure the efficiency of any indicating, recording, or control installation. Whether you are planning new construction, modernizing existing installations or adding to present equipment, FALSTROM offers long years of experience and the most modern facilities for fabricating to your specifications or recommending standard designs. In any case, by specifying FALSTROM you specify the highest possible quality metal working techniques known to the industry. Estimates on your needs will be supplied promptly—call or write FALSTROM to arrange a consultation.

WRITE FOR BULLETIN #125

SINCE 1870 **FALSTROM COMPANY**
92 Falstrom Court, Passaic, New Jersey
DESIGNERS, ENGINEERS AND BUILDERS OF CUSTOM METAL PRODUCTS FOR INDUSTRY

*Instruments*
THE MAGAZINE OF MEASUREMENT
INSPECTION · TESTING · CONTROL

Vol. 25 **DECEMBER, 1952** No. 12

## FEATURE ARTICLES

Sources and Control of River Pollution ..................... 1714
By Richard D. Hoak

Butterfly Control Valves ..................... 1717
By Charles A. Dally

Inspection and Measurement by Ultrasonics ..................... 1720
By R. H. Frank

Steel-Plant Instrument-Department Problems—Personnel Training and Maintenance Facilities ..................... 1722
By J. H. Cuthbert

**THE MONTH'S NEW INSTRUMENTS**....... 1677

**INSTRUMENTS ON THE MARCH**

Miniature Air Conditioner ..................... 1756

Prediction of Electronic Failures ..................... 1756

Tension Measurements ..................... 1756

Analysis by X-ray Spectrometer ..................... 1758

**MANUFACTURERS' NEW LITERATURE**...... 1768

**OTHER REGULAR FEATURES**

Editorial Comment ..................... 1675

Calendar of Important Instrumentation Events ..................... 1712

Product Index ..................... 1766

Advertisers' Index ..................... 1776

***JOURNAL* of the INSTRUMENT SOCIETY OF AMERICA** .... 1725

Operation of a Semi-continuous Process Using the Kinegraphic Control Board ..................... 1727
By John E. Read and John Johnston Jr.

Improved Flow Control With Long Lines ..................... 1733
By W. E. Vannah and A. R. Catheron

Putting The Instrument To Work ..................... 1737
By H. A. Hulsberg

## *JOURNAL* of the SOUTHERN CALIFORNIA METER ASSOCIATION

Electronic Recorders ..................... 1745
By Emory Ferree

**Copyright 1952 by The Instruments Publishing Company, Inc.** **Office of publication, 1600 North Main Street, Pontiac, Illinois. Executive and Editorial Office, 921 Ridge Avenue, Pittsburgh 12, Pennsylvania.**

**Entered as second class matter, October 14, 1949, at the post office at Pontiac, Illinois, under the act of March 3, 1879.**

# LEWIS PORTABLE PYROMETER POTENTIOMETERS

## FOR MEASURING TEMPERATURES ELECTRICALLY

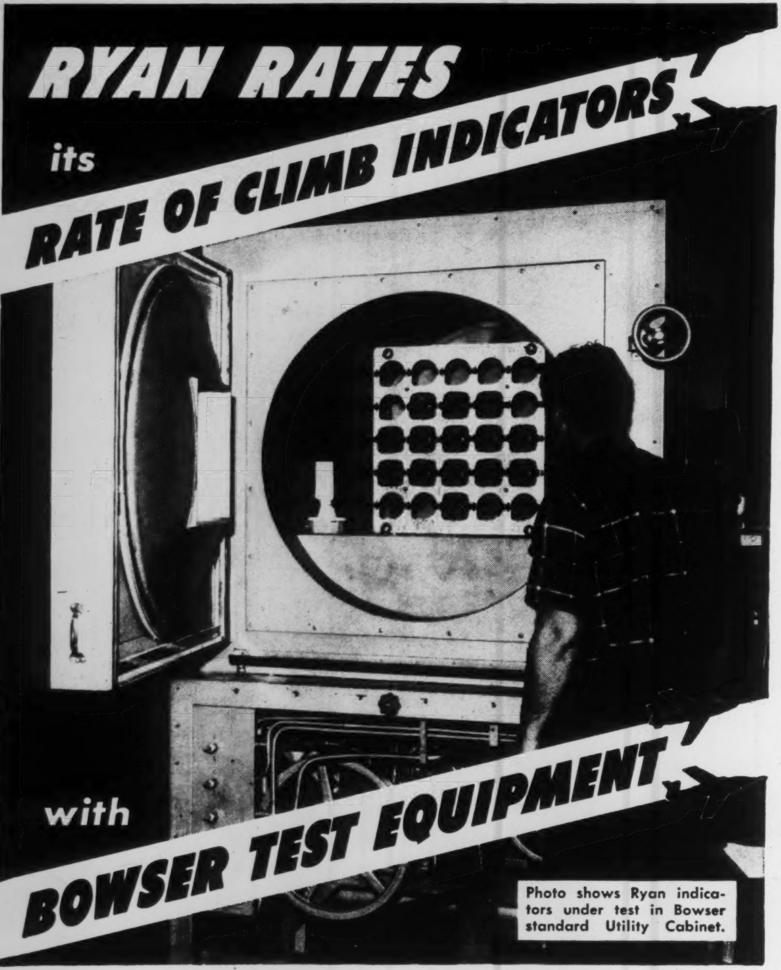
- **IN MOVING VEHICLES**
- **IN AIRCRAFT**
- **IN THE LABORATORY**

**ACCURATE, DIRECT-READING, EASILY-OPERATED INSTRUMENTS, WITH ELECTRICAL COLD-JUNCTION COMPENSATION.**

These potentiometers have been used for years by the leading motor car and aircraft manufacturers for proving-ground and flight-test work as well as in the laboratory.

- Three models from which to choose the instrument for your application.
  - Model 13PO2, with single temperature scale.
  - Model 14PO (illustrated) with high and low temperature scales.
  - Model 78PO with one temperature and one millivolt scale or two temperature scales, for different thermocouple materials.
- Housed in a sturdy hardwood case, approximately 11⅜" long, 10" wide and 7⅞" high. Weight approximately 17 lbs., shipping weight 20 lbs.
- For dependable temperature instrumentation, use these potentiometers with LEWIS leads, selector switches and thermocouples.

**THE LEWIS ENGINEERING CO.**
NAUGATUCK, CONNECTICUT
*Manufacturers of Complete Temperature Measuring Systems for Aircraft*



RYAN RATES its RATE OF CLIMB INDICATORS with BOWSER TEST EQUIPMENT

Photo shows Ryan indicators under test in Bowser standard Utility Cabinet.

Ryan Industries of Detroit supplies USAF with rate of climb indicators which must meet rigid test specifications under conditions of high altitude and extreme temperatures.

Standard Bowser test units perform this all-important testing job for Ryan. Indicators are tested at temperatures from −67°F. to +160°F., at altitudes varying from sea level to 50,000 feet.

Rapid pull down time after each test run enables Ryan to deliver *more* of these vital instruments to USAF . . . each pre-tested under accurate flight conditions.

Why don't you take advantage of long ***continuous*** experience? Consult Bowser, the pioneer.

PROGRESS REPORT . . . Three more high altitude Walk-In test chambers are currently under construction in Bowser's enlarged plant.

**BOWSER**
**TECHNICAL REFRIGERATION**
DIVISION BOWSER INC.
TERRYVILLE • CONN.

BOWSER TECHNICAL REFRIGERATION, Terryville, Conn.
*Send information on test equipment checked:*

☐ High Temperature ☐ Fungus Resistance
☐ Low Temperature ☐ Rain and Sunshine
☐ Temperature Shock ☐ Sand and Dust
☐ Humidity ☐ Immersion
☐ Altitude ☐ Explosion Proof
☐ Walk-In Rooms ☐ Vapor Tight
☐ Special Engineering

Name__________ Pos.__________
Company__________
Street__________
City__________ Zone____ State__________

12-7

# Instruments

THE MAGAZINE OF MEASUREMENT
INSPECTION · TESTING · CONTROL

**Published by**
**The Instruments Publishing Company**
**921 Ridge Avenue**
**Pittsburgh 12, Penna.**

Richard Rimbach, *Publisher*
M. F. Behar, *Editor*
Milton H. Aronson, *Technical Editor*
David S. Aland, *Assistant Editor*

DISTRICT OFFICES AND MANAGERS

*Altadena, Calif.*, M. D. Pugh, 2721 N. Marengo Ave., Telephone Sycamore 7-2894

*Boston* 14, James Condon, 133 Marlborough St., Telephone Commonwealth 6-5961

*Chicago* 1, Harold W. Haskett, Room 2101, 228 N. La Salle St., Tele. Central 6-8963

*Cincinnati* 5, Harold W. Haskett, 742 Elberon Ave., Telephone Grandview 4323

*St. Louis* 1, *Mo.*, James R. Wright (Missouri, Southern Illinois, Southern Indiana), Stephen E. Wright (Iowa, Nebraska, Kansas), 411 N. 10th St., Telephone Chesnut 1965.

*New York* 17, Richard Rimbach, Jr., Room 349, 551 Fifth Ave., Telephone Murray Hill 2-0821

*Philadelphia* 40, William J. Gallagher, Room 1102, Beury Bldg., 3701 N. Broad St., Telephone Baldwin 9-9940

*Pittsburgh* 12, C. Goldcamp, 921 Ridge Ave., Telephone Fairfax 1-0161

*Dallas, Texas*, Edward F. Wright, Oklahoma-Texas-Louisiana, 505 N. Ervay, Rm. 310.

*London*, W.C. 2, England. John C. N. Hughes, Crown House, 143-147 Regent St., London W. 1, England

COVER STORY

The new Boron Trifluoride Neutron Counter of RCL, said to be the most efficient neutron counter available, is "heli-arc" aluminum welded and tested for leaks with a CEC helium mass-spectrometer-type leak detector.

CORRECTION

The following was omitted from the picture title of the October cover, showing the Mitchell Station control room: The James Saunders Co., Dayton, Ohio, was the electrical equipment contractors for this massive job, which included all the switch boards and panels, wiring, piping for instrument controls, etc.

MEMBER
ABC
Audit Bureau of Circulation

SUBSCRIPTION RATES
*For One and Two Years.*

United States, U. S. Possessions, and Canada $4.00, $7.00.

Latin America and Australia $5.00, $8.00.

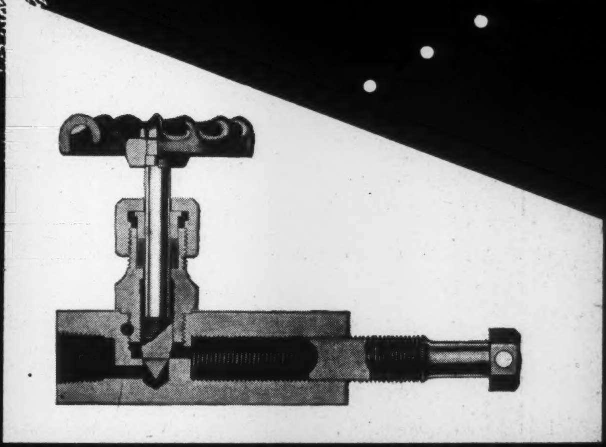
All other countries except those noted below $6.00, $10.00.

For the present, subscriptions not accepted from Austria, Bulgaria, China, Czechoslovakia, Eastern Zone Germany, Hungary, India, Poland, Romania, Russia and Yugoslavia.

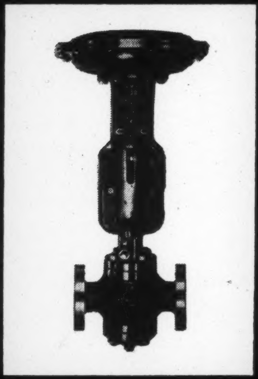
Payments from outside the U. S. A. must be in the form of an International Money Order or check on a U. S. Bank.

Position and company connection as well as products manufactured must be indicated in all subscription orders.

# ON GUARD . . .



# for safe, easy stem lubrication

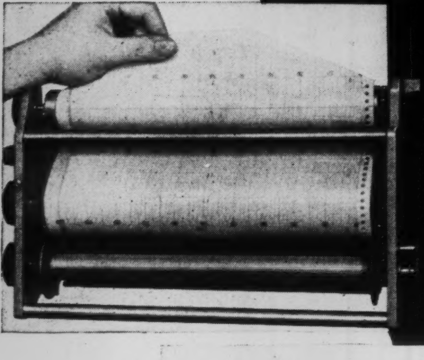


The isolating valve in the stem lubricator of the Honeywell Series 700 Valve affords maximum safety against leakage when replenishing stem lubricant . . . tight-fitting conical plug and machined seat assure leakless shut-off . . . pinned bonnet prevents accidental removal. The Honeywell Series 700 wide band proportional valve comes in a full range of styles and sizes . . . has *all* the features you look for in a fine valve. Write today for your copy of Bulletin 700-2.

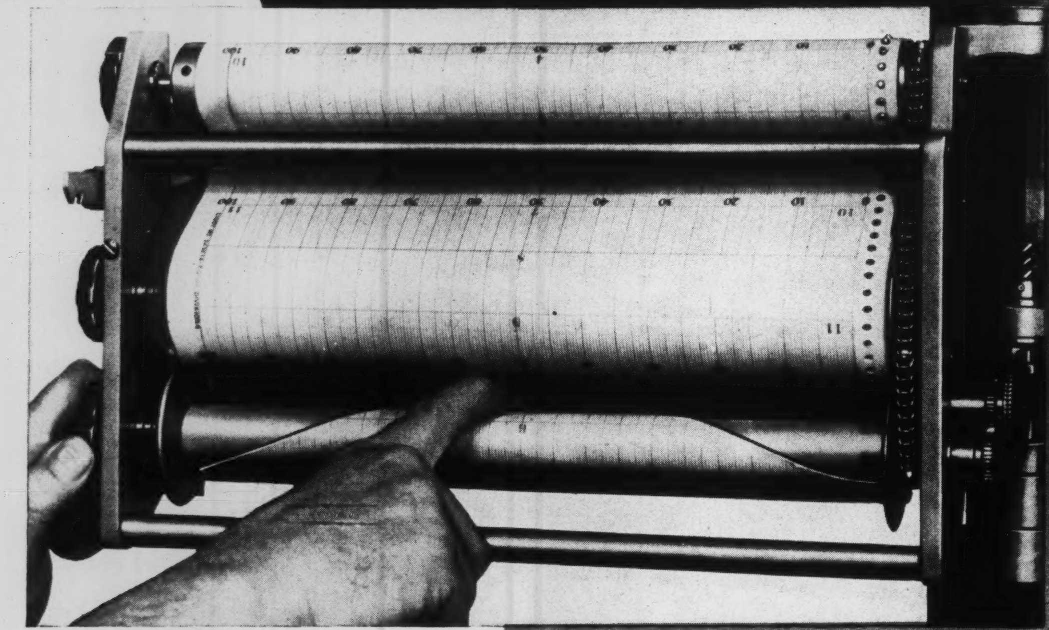
MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 1908 Windrim Avenue, Philadelphia 44, Pa.

MINNEAPOLIS
**Honeywell**
VALVE PRODUCTS

*First in Controls*



# this simple way!



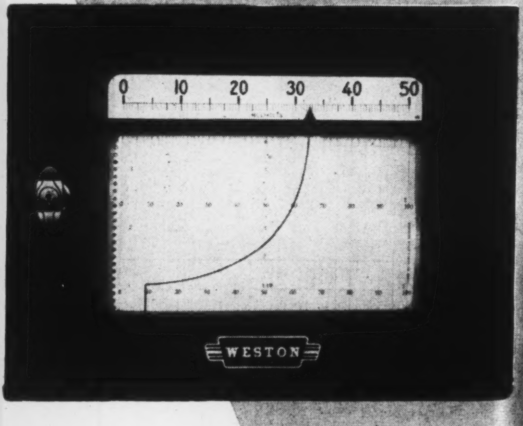
# NEW Simplified Recording Potentiometer

## by WESTON!

Chart changing is a simple 1-2 operation on the Weston Recording Potentiometer. First, note that the chart frame has swung wide open . . . *a full 180°* . . . for complete accessibility. You then insert the chart supply in the frame, draw the chart over the timing drum and down across the front of the frame as illustrated. There are no loose pieces to handle . . . and the whole operation takes but a few seconds!

And there are many more features that make this the simplest, most flexible and efficient recorder available. You change chart speeds, for example, by a simple screwdriver adjustment. You change ranges by simply inserting the desired range standard. To service the amplifier, you quickly remove it by taking out two screws and pulling two plugs.

The whole story about this simple and dependable high-speed recorder is available in booklet form. Ask your local Weston representative or write . . . WESTON Electrical Instrument Corp., 617 Frelinghuysen Ave., Newark 5, New Jersey.

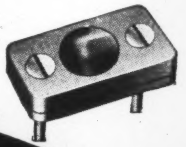


WESTON TAG 1628

**WESTON** *Instruments* . . . INDICATE—RECORD—CONTROL

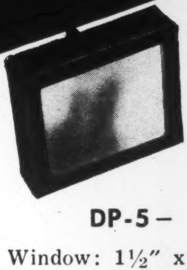
**INTERNATIONAL RECTIFIER CORPORATION**

# Selenium Photo-Cells



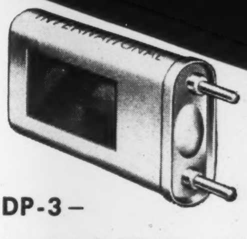
INTERNATIONAL

[redacted]



**DP-5 –**

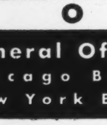
Hermetically sealed. Window: 1½″ x 1½″. 600 microamperes at 100 foot-candles illumination. Corrosion-resistant finish. Threaded terminals.



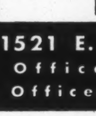
**DP-3 –**

Hermetically sealed. Window: 9/16″ x 3/8″. 50 microamperes at 100 foot-candles illumination. Terminals fit standard crystal mounting base. Supplied with corrosion-resistant finish.

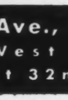
## STANDARD UNMOUNTED PHOTO-ELECTRIC CELLS



**A 15**
2″ diam.
750 microamperes*

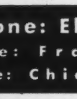


**A 10**
1¾″ diam.
500 microamperes*

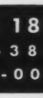


**A 5**
1⅛″ diam.
250 microamperes*

**B 10**
1-11/16″ x 7/8″
340 microamperes*



**B 5**
1-7/16″ x 41/64″
220 microamperes*



**B 2**
23/32″ x 7/16″
75 microamperes*

* *At 100 foot-candles illumination and 100 ohms external resistance.*

**INTERNATIONAL RECTIFIER CORPORATION**

General Offices: 1521 E. Grand Ave., El Segundo, Calif. • Phone: El Segundo 1890
Chicago Branch Office: 205 West Wacker Drive • Phone: Franklin 2-3889
New York Branch Office: 12 West 32nd Street, N. Y. 1 • Phone: Chickering 4-0017

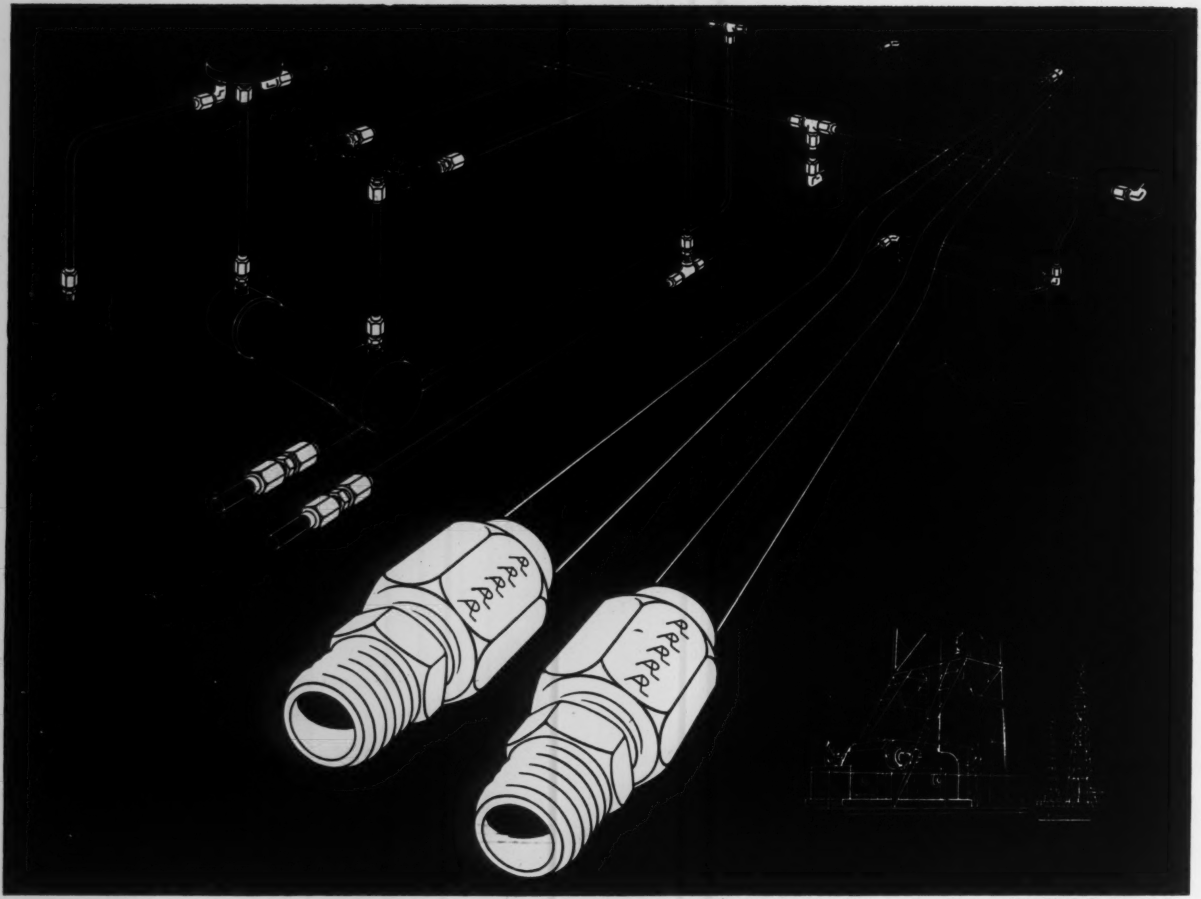
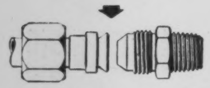


Illustration based on Unit Rig oil filter system. Courtesy Unit Rig & Equipment Co.

# Tube it up...Forget it!

## WITH ALUMINUM TRIPLE-LOK FITTINGS

**This does it**



Triple-lok . . . 3-piece flare fitting famous for its sleeve . . . the easiest way to install tubing systems. Made in brass, steel, stainless steel, aluminum alloy.

**Precision Mark of**

**Leakproof Tube Fittings**

In the oil fields, for example, where equipment is out in the open, subject to all kinds of atmospheric conditions. Here you'll find precision-made, corrosion-resistant, *leakproof* PARKER ALUMINUM Triple-lok Fittings on many types of equipment. Such as the versatile Unit Rig draw works . . . with ALUMINUM Triple-lok on oil filter, oil pump, and air supply lines.

PARKER ALUMINUM Triple-lok Fittings are designed and precision made to be *leakproof* under even the severest conditions of vibration—elevated temperatures—high pressures—and repeated reassembly . . . and to hold *leakproof* beyond tube bursting pressures. That's why you'll find them on oil field equipment . . . on control lines for delicate instrumentation . . . wherever failure-proof tubing systems are demanded.

So tube it up and forget it . . . with PARKER Triple-lok Fittings. Distributors listed alongside now have stocks of ALUMINUM Triple-lok Fittings in the popular, medium sizes.

For PARKER Tube Fitting Catalog 4300, call your PARKER Distributor, or write The PARKER Appliance Company, 17325 Euclid Ave., Cleveland 12, Ohio.

**Parker**

**TUBE FITTINGS • VALVES • O-RINGS**

Plants in Cleveland • Los Angeles • Eaton, Ohio • Berea, Ky.

**Parker**

**INDUSTRIAL TUBE FITTING**

**STOCKS CARRIED BY**

| | |
|---|---|
| AKRON, O. | B. W. Rogers Co.<br>850 So. High St. (9) |
| BALTIMORE, Md. | Carey Machinery & Supply Co.<br>3501 Brehms Lane (13)<br>Whitehead Metal Products Co.<br>4300 E. Monument St. (5) |
| BEAUMONT, Tex. | Standard Brass & Mfg. Co.<br>705 Milam St. |
| BOSTON, Mass. | A. E. Borden Co., Inc.<br>176 Brookline Ave. (15) |
| BRYSON CITY, N. C. | Wallace Co. of Carolina<br>P.O. Box 572 |
| BUFFALO, N. Y. | Whitehead Metal Products Co.<br>2128 Elmwood Ave. (17) |
| CAMBRIDGE, Mass. | Whitehead Metal Products Co.<br>281 Albany St. (39) |
| CEDAR RAPIDS, Ia. | Globe Machinery & Supply Co.<br>309 8th Ave., S.E. |
| CHICAGO, Ill. | Wallace Tube Co.<br>1300 Diversey Parkway (14) |
| CINCINNATI, O. | Williams & Co.<br>3231 Fredonia Ave. (29) |
| CLEVELAND, O. | W. M. Pattison Supply Co.<br>777 Rockwell Ave. (14)<br>B. W. Rogers Co.<br>1900 Euclid Ave. (15)<br>Williams & Co.<br>3700 Perkins Ave. (14) |
| COLUMBUS, O. | Williams & Co.<br>851 Williams Ave. (8) |
| DALLAS, Tex. | Metal Goods Corp.<br>6211 Cedar Springs Rd. (9) |
| DAVENPORT, Ia. | Globe Machinery & Supply Co.<br>410 East Second St. |
| DAYTON, O. | J. N. Fauver Co.<br>1534 Keystone Ave. (10) |
| DENVER, Colo. | Metal Goods Corp.<br>2425 Walnut St. (2) |
| DES MOINES, Ia. | Globe Machinery & Supply Co.<br>East First & Court Ave. (6) |
| DETROIT, Mich. | J. N. Fauver Co.<br>49 West Hancock St. (1) |
| HARRISON, N. J. | Whitehead Metal Products Co.<br>1000 South Fourth Ave. |
| HOUSTON, Tex. | Metal Goods Corp.<br>711 Milby St. (3)<br>Standard Brass & Mfg. Co.<br>2018 Franklin St. (1) |
| INDIANAPOLIS, Ind. | Korhumel Steel & Aluminum Co.<br>1916 N. Meridian St. (2) |
| KANSAS CITY, Mo. | Metal Goods Corp.<br>1300 Burlington Ave.<br>North Kansas City (16) |
| KNOXVILLE, Tenn. | Leinart Engineering Co.<br>412 E. 5th Ave. (5) |
| LOS ANGELES, Cal. | Haskel Engineering & Sup. Co.<br>721 W. Broadway,<br>Glendale (4)<br>Metropolitan Supply Co.<br>353 East 2nd St. (12) |
| MEMPHIS, Tenn. | J. E. Dilworth Co.<br>730 South Third St. |
| MILWAUKEE, Wis. | Marman Belting & Supply Co.<br>522 W. State St. (3)<br>Wallace Co. of Wisconsin<br>838 So. 6th St. (4) |
| MINNEAPOLIS, Minn. | Vincent Brass & Copper Co.<br>124 Twelfth Ave., So. (15) |
| NEW ORLEANS, La. | Metal Goods Corp.<br>432 Julia St. (13) |
| NEWPORT NEWS, Va. | Noland Company<br>27th St. & Virginia Ave. |
| NEW YORK, N. Y. | Nielsen Hydraulic Equipment Inc.<br>298 Lafayette St. (12)<br>Whitehead Metal Products Co.<br>303 West 10th St. (14) |
| PHILADELPHIA, Pa. | Louis H. Hein Co.<br>15 West Lancaster Ave.<br>Ardmore, Pa.<br>Whitehead Metal Products Co.<br>1955 Hunting Park Ave. (40) |
| PITTSBURGH, Pa. | Williams & Co.<br>901 Pennsylvania Ave. (33) |
| PORTLAND, Ore. | Hydraulic Power Equipment Co.<br>2316 N. W. Savier St. (10) |
| ROANOKE, Va. | Noland Company<br>11 Salem Ave. (10) |
| ROCKFORD, Ill. | Rockford Tool & Transmission Co.<br>802 Broadway |
| SAN FRANCISCO, Cal. | General Machinery & Sup. Co.<br>1346 Folsom St. (3) |
| SEATTLE, Wash. | Palmer Supply Co.<br>222 Westlake Ave., North (9) |
| ST. LOUIS, Mo. | Metal Goods Corp.<br>5239 Brown Ave. (15) |
| SYRACUSE, N. Y. | Whitehead Metal Products Co.<br>207 West Taylor St. (14) |
| TOLEDO, O. | Williams & Co.<br>650 E. Woodruff Ave. (2) |
| TULSA, Okla. | Ardun Supply Co.<br>317 S. Detroit<br>Metal Goods Corp.<br>302 North Boston (3) |
| CANADA | Railway & Power Engineering<br>Corp. Ltd. |
| EXPORT | Mercator Corp.<br>438 Walnut St.<br>Reading, Pa. |

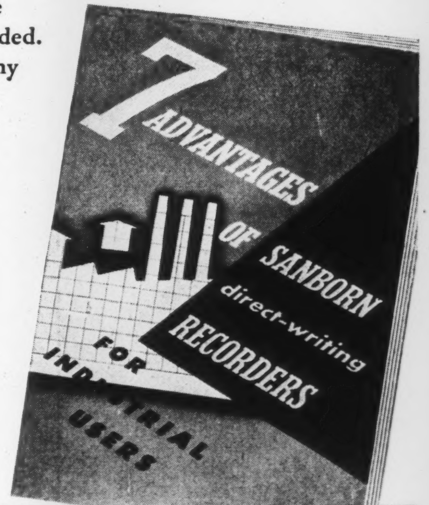
**ILLUSTRATING**
**ONE REASON WHY**

You can't beat the system

**WHEN IT'S A**

**SANBORN**
**Recording System**

**SANBORN** records are *inkless* and *permanent.* They are produced by a *heated stylus ribbon* which melts the heat-responsive, plastic-coated surface of the recording paper (Sanborn Permapaper). The result is a clear, sharp tracing showing *fine* details of the phenomena being recorded. This is just *one* of many **SANBORN** advantages.



**Learn MORE about SANBORN in a new, interesting, and pertly illustrated 16 page booklet, "7 Advantages of Sanborn Recorders for Industrial Users." Send for your copy today.**

**Please send me a copy of**
**"7 Advantages of Sanborn Recorders for Industrial Users."**

**NAME**____________________________

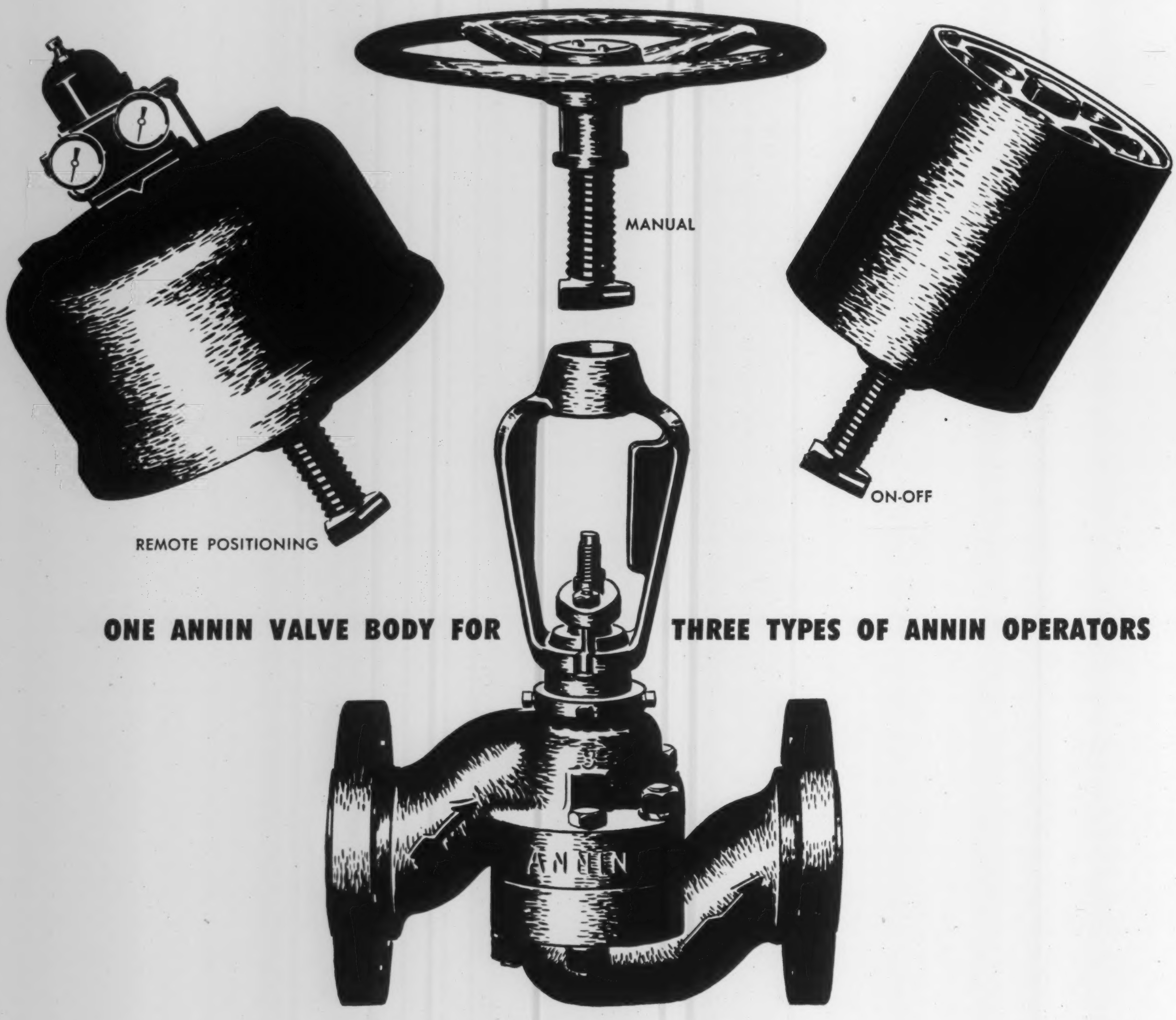
**TITLE**____________________________

**COMPANY**________________________

**ADDRESS**_________________________

**SANBORN CO.** **INDUSTRIAL DIVISION**
**CAMBRIDGE 39, MASS.**

# YOU CAN CUT CONTROL VALVE INVENTORIES *in half!*

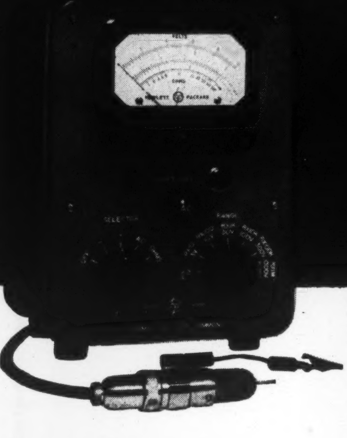


## ONE ANNIN VALVE BODY FOR THREE TYPES OF ANNIN OPERATORS

A single Annin valve body is standard for use with any of three types of Annin operators. Furthermore, each size of operator fits two sizes of valve bodies. Think how your inventory of critical control valves can be cut: For any installation the valve body is selected by size and alloy, then assembled with operator desired, and your control valve is complete (positioner unit built-in)—ready for service under specified conditions. In addition, all valve bodies carry a 1000# rating. Interchangeable flanges series 15, 30 and 60 are split-ring mounted to meet any requirement. Write today for detailed information. Ask for Catalog 1500B.

**Complete Coverage!** **2 to 700,000,000 cps**

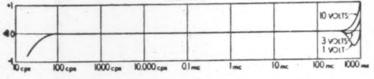
**-hp- precision voltmeters for every ac voltage measuring need!**



| INSTRUMENT | PRIMARY USES | FREQUENCY RANGE | VOLTAGE RANGE | INPUT IMPEDANCE | PRICE |
|---|---|---|---|---|---|
| -hp- 400A | General purpose ac measurement | 10 cps to 1 mc | .005 to 300v<br>9 ranges | 1 megohm<br>24 μμfd shunt | $185.00 |
| -hp- 400B | Low frequency ac measurements | 2 cps to 100 kc | .005 to 300v<br>9 ranges | 10 megohms<br>24 μμfd shunt | $195.00 |
| -hp- 400C | Wide range ac measurements High sensitivity | 20 cps to 2 mc | .0001 to 300v<br>12 ranges | 10 megohms<br>15 μμfd shunt | $200.00 |
| -hp- 404A | Portable, battery operated | 2 cps to 50 kc | .0005 to 300v<br>11 ranges | 10 megohms<br>20 μμfd shunt | $185.00 |
| -hp- 410B | Audio, rf, VHF measurements; dc voltages; resistances | 20 cps to 700 mc | 0.1 to 300v<br>7 ranges | 10 megohms<br>1.3 μμfd shunt | $245.00 |

**New -hp- 410B Vacuum Tube Voltmeter**

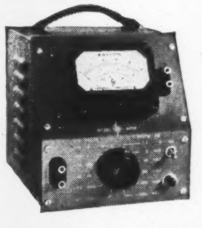
Gives same wide range and flat response performance as -hp- 410A voltmeter, but sets new standard of mechanical convenience, ease of operation, minimum bench space. Readily detachable probe leads fit in handy compartment in new, compact, streamlined case. Special diode probe design places capacity of approximately 1.3 μμfd across circuits under test. Shunt impedance is extremely high—10 megohms at low frequencies—thus circuits under test are not disturbed and true voltage readings are assured. New -hp- 410B provides 1 db accuracy from 20 cps to 700 mc; and may be used as a voltage indicator up to 3,000 mc. Also serves as audio or dc voltmeter or ohmmeter.



Response, -hp- 410B Voltmeter

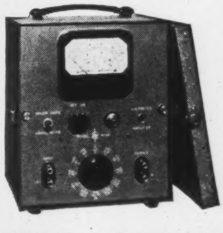
**HEWLETT-PACKARD CO.**
2251C Page Mill Road • Palo Alto, Calif., USA

Sales representatives in principal areas
Export: Frazar & Hansen, Ltd.
San Francisco • New York • Los Angeles



**-hp- 400C Vacuum Tube Voltmeter**

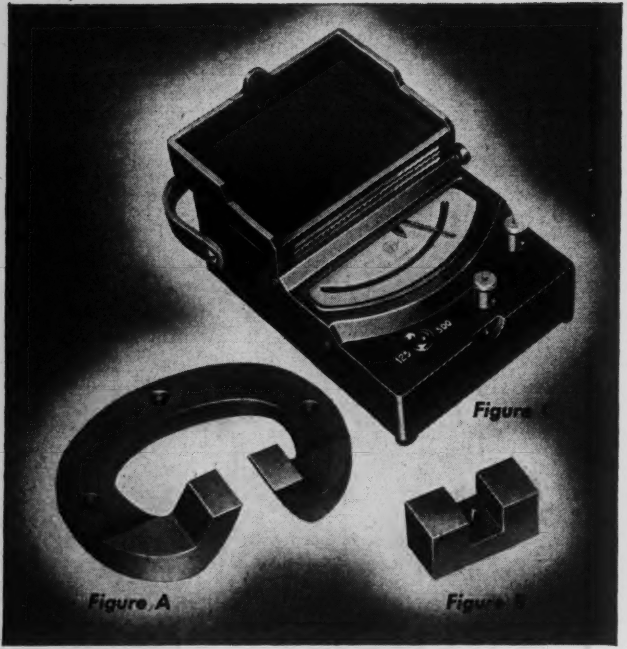
General purpose precision voltmeter offering wide range, high sensitivity, high stability. Quick-reading linear meter scale shows RMS volts or dbm direct from −72 dbm to +52 dbm. Broad usefulness includes direct noise or hum measurements, transmitter and receiver voltages, audio, carrier or supersonic voltages, or power gain. Also may be used as 54 db amplifier to increase signal level to oscilloscopes, recorders, power amplifiers, etc.



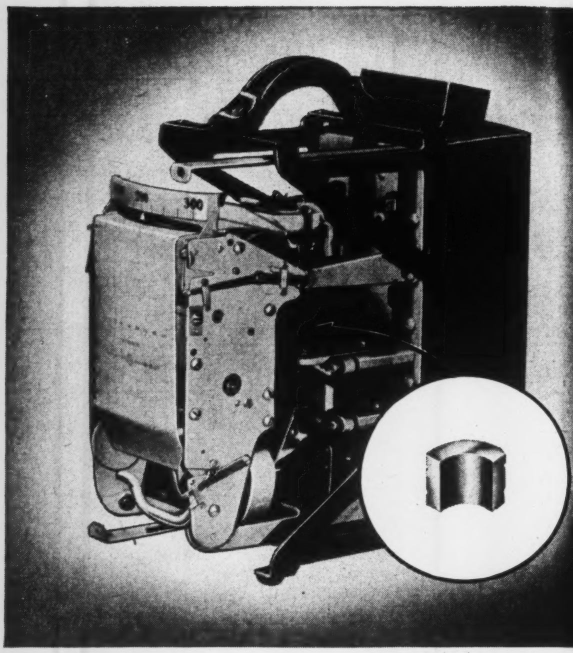
**-hp- 404A Battery-Operated Voltmeter**

Precision vacuum tube instrument for general voltage measurement where ac power is not available. Compact, portable, splash-proof—ruggedly constructed for field operations. Wide voltage range permits all types of measurements including remote broadcast line and carrier checks, strain gauge system tests, telemetering and geophysical circuit measurements, etc. In the laboratory, offers completely hum-free measurements of very low noise level.

**HEWLETT-PACKARD -hp- INSTRUMENTS**

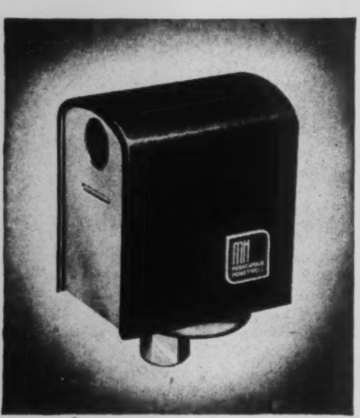


**INSTRUMENTS**—Fig. A is damping magnet once used in GE indicators. Fig. B is tiny Carboloy magnet now used. It permits smaller indicator design (Fig. C), cuts materials and assembling costs . . . speeds up calibrations.



**METERS**—In this portable current recorder a Carboloy permanent magnet cuts costs by eliminating power-supplying parts. It also reduces recorder's weight by 10 pounds.

# How Carboloy permanent magnets improve electrical products



**CONTROLS**—Switches in compact Minneapolis-Honeywell controls use permanent magnets to give safer snap action, help quench arcs. The magnets are exceptionally stable; provide uniform high energy for the life of the control.

**Want** to cut down product size, weight? Build a better-performing product for less money?

Then check the possibility of using Carboloy Alnico permanent magnets wherever you need *lasting* magnetic energy.

Carboloy permanent magnets are simple, self-containing sources of energy that *never* fail. They are powerful in small sizes. Need no outside power supply, no maintenance. They help reduce fabrication costs by eliminating wires, coils and operating parts. Above all, they let you simplify design . . . build a lighter, more compact, finer-performing product at a saving.

On these pages you'll see how others got the jump on competitors by using permanent magnets. Perhaps you'll get an application idea from reading about them.

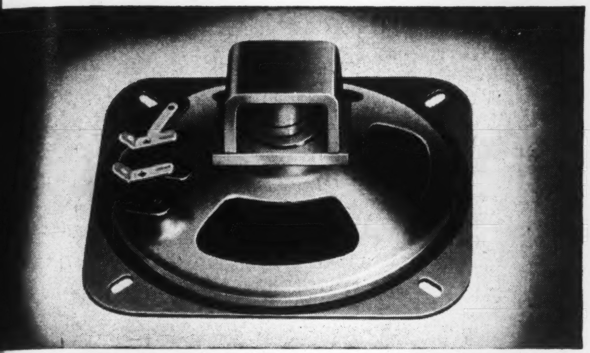
### CARBOLOY SERVICES

If so, check Carboloy magnet engineers for free, expert advice and an assist in design and application. Look to Carboloy production lines, too, for the uniform, high-energy Alnico magnets you'll need for best results — all sizes, all shapes; cast or sintered to your specifications.

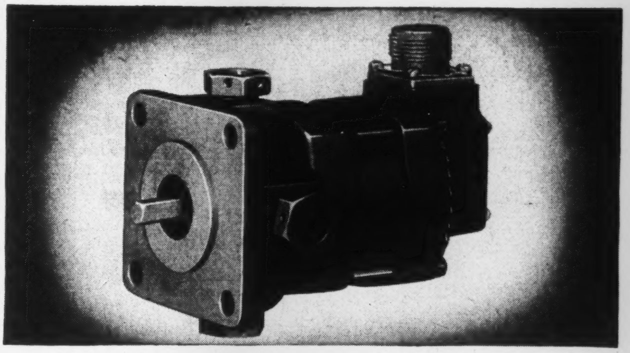
Send coupon for free Magnet Design Manual PM-101 and Standard Stock Catalog PM-100.

**CARBOLOY**

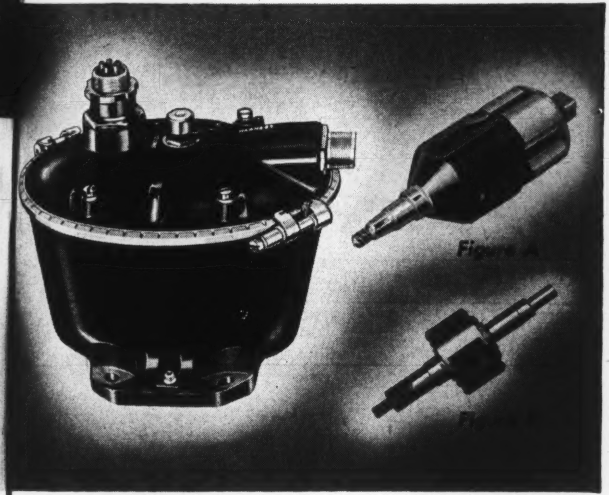
**DEPARTMENT OF GENERAL ELECTRIC COMPANY**
**11199 East 8 Mile Street, Dept. A, Detroit 32, Michigan**



**SPEAKERS**—In speakers, permanent magnets replace larger electromagnets in field structure. Current passing through Alnico's *uniform* field makes voice coil and cone vibrate in proportion to voltage; tone is truer.



**GENERATORS**—When GE engineers had only 6″ x 6″ area for jet's tachometer generator, they whipped design problem with a tiny permanent magnet. It eliminated coils and wires, supplied the powerful energy required.



**MAGNETOS**—To Scintilla Magneto Division, Bendix Aviation Corp., weight savings are vital in their aircraft products. Fig. A shows chrome rotor weighing approximately 4 lbs. 9 ozs. Fig. B shows newer model rotor using Carboloy Alnico. It weighs only 2 lbs. 4 ozs.

## ADVANTAGES OF CARBOLOY PERMANENT MAGNETS

1. Simple — no operating parts
2. Uniformly powerful
3. Permanent source of energy
4. No coils to wire
5. Cool-running
6. No operating costs
7. No power failures
8. Combine electrical and mechanical features
9. Simplify mechanical assemblies
10. Uninterrupted operation
11. Moisture-resistant
12. Create savings

"Carboloy" is the trademark for the products of Carboloy Department of General Electric Company

**Plants at Detroit, Michigan; Edmore, Michigan; and Schenectady, New York**

## CARBOLOY ALNICO PERMANENT MAGNETS

*Mail Coupon Today*

Carboloy Department of General Electric Company
11199 East 8 Mile Street, Dept. A, Detroit 32, Michigan

Gentlemen:

Please rush me, without cost or obligation, copies of Permanent Magnet Design Manual PM-101 and Standard Stock Catalog PM-100.

NAME____________________

POSITION____________________

COMPANY NAME____________________

ADDRESS____________________

CITY__________ZONE_____STATE_____

# engineered simplicity

400
800
1200
1600
2000
WHEELCO CAPACILOG

## capacilog STRIP CHART recorder

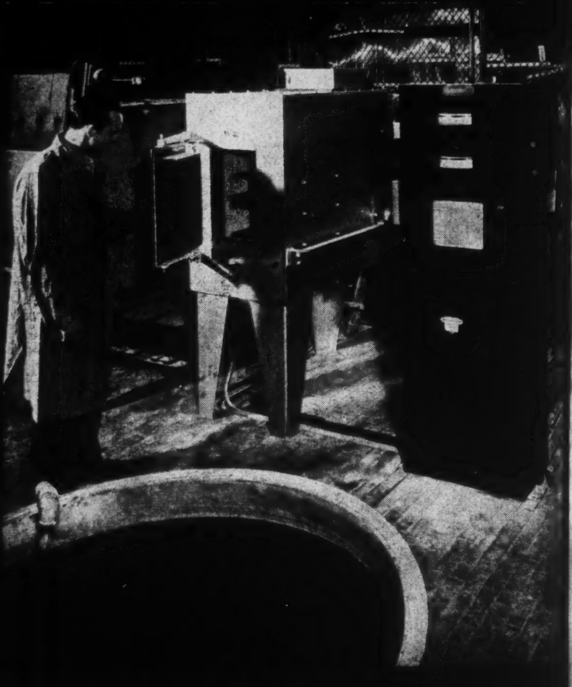
instantaneous "no contact" controlling

**Single Point Electronic
Strip Chart Recorder-Controller**

ngineered simplicity gives operating accuracy and echanical stamina to Capacilog Recorder-Controllers.

limination of mechanical clamping mechanism between dicating pointer and control unit allows instantaneous ecording action. Design simplicity confines moving parts o a minimum; maintenance is easy, mechanical wear is egligible. An added convenience is the plug-in chassis or facilitating quick replacement.

apacilog strip chart Recorders are available with ither high or low temperature measuring systems for lectrical or pneumatic control. Write for Bulletin C2-2.



A Precision Product of Wheelco Instrumentality

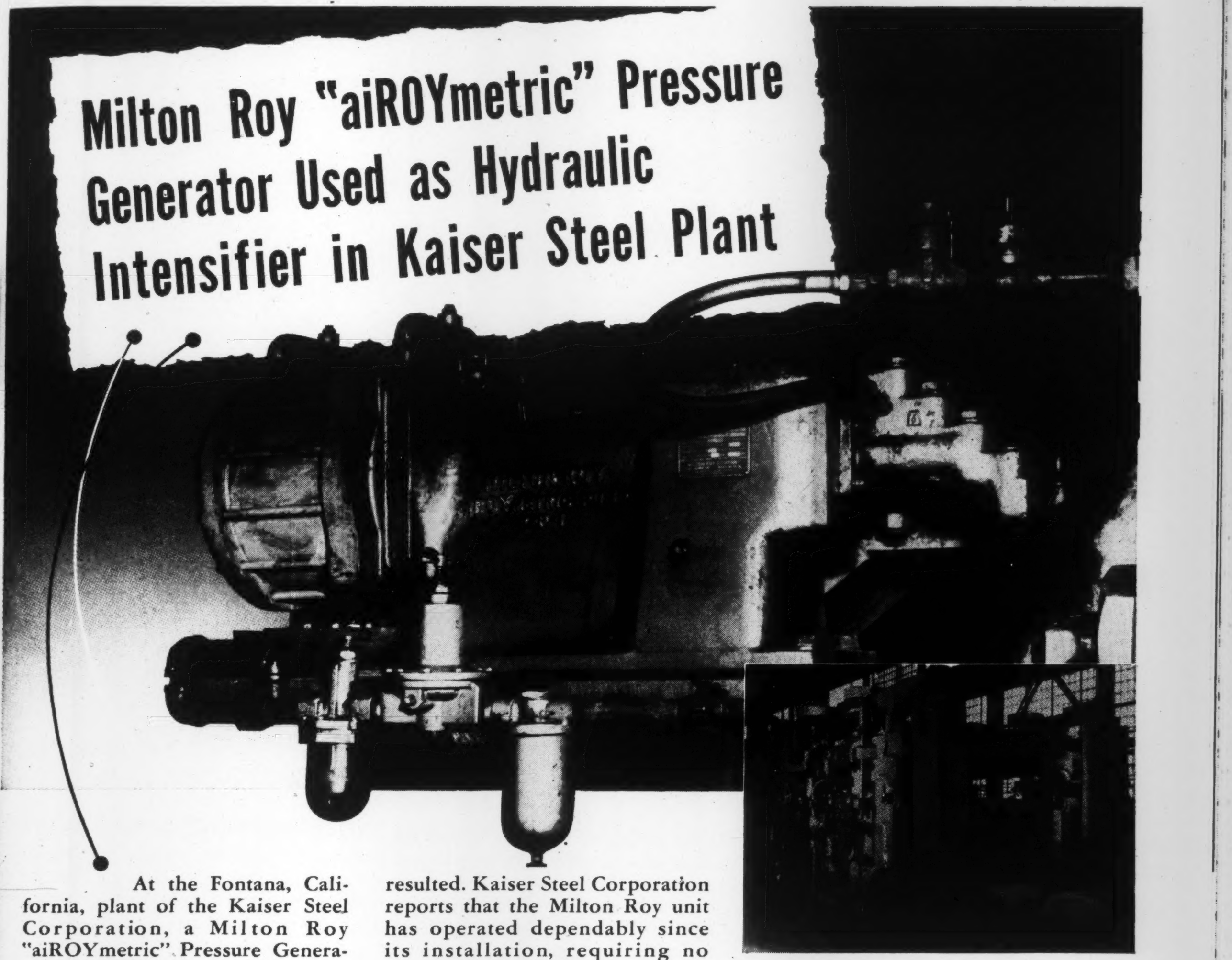
BARBER COLMAN

**wheelco instruments division**

BARBER-COLMAN COMPANY • ROCKFORD, ILLINOIS, U. S. A.

1218 ROCK STREET

# Milton Roy "aiROYmetric" Pressure Generator Used as Hydraulic Intensifier in Kaiser Steel Plant



At the Fontana, California, plant of the Kaiser Steel Corporation, a Milton Roy "aiROYmetric" Pressure Generator is used as an hydraulic intensifier to hold pressure on a heavy leveler, which gives a true level surface to rolled steel.

The unit holds constant pressure of 3500 pounds on four jacks, which in turn hold down the top roll assembly of the 110″ plate leveler. The hydraulic fluid used is soluble oil plus water at 90° F. Pumping volume varies from zero up to 10 gph, as required.

The Pressure Generator replaces a large, straight, single-stroke intensifier which required frequent delays for repriming . . . considerable maintenance and downtime resulted. Kaiser Steel Corporation reports that the Milton Roy unit has operated dependably since its installation, requiring no maintenance and eliminating downtime. On the basis of its performance, Kaiser is installing a duplicate unit to perform the very same job on a light leveler.

This is just one instrumentation application of Milton Roy Pressure Generators. Other applications include use as power units for hydraulic jacks and for small presses. The Pressure Generator is used by industry wherever constant automatic pressure is required in hydraulic systems, or for hydrostatic testing.

The Milton Roy unit is fully automatic. It pumps continuously at maximum capacity until the desired system pressure is developed. It then maintains the required pressure automatically, eliminating the constant attention of an operator. Typical capacities range from 4 gph to 405 gph; pressures from 25-170 psi to 4,000-25,000 psi. Ordinary plant air supply is used.

For more information on Milton Roy Pressure Generators used as precise industrial instruments, call the Milton Roy representative listed in your classified telephone directory. Or write directly to us.

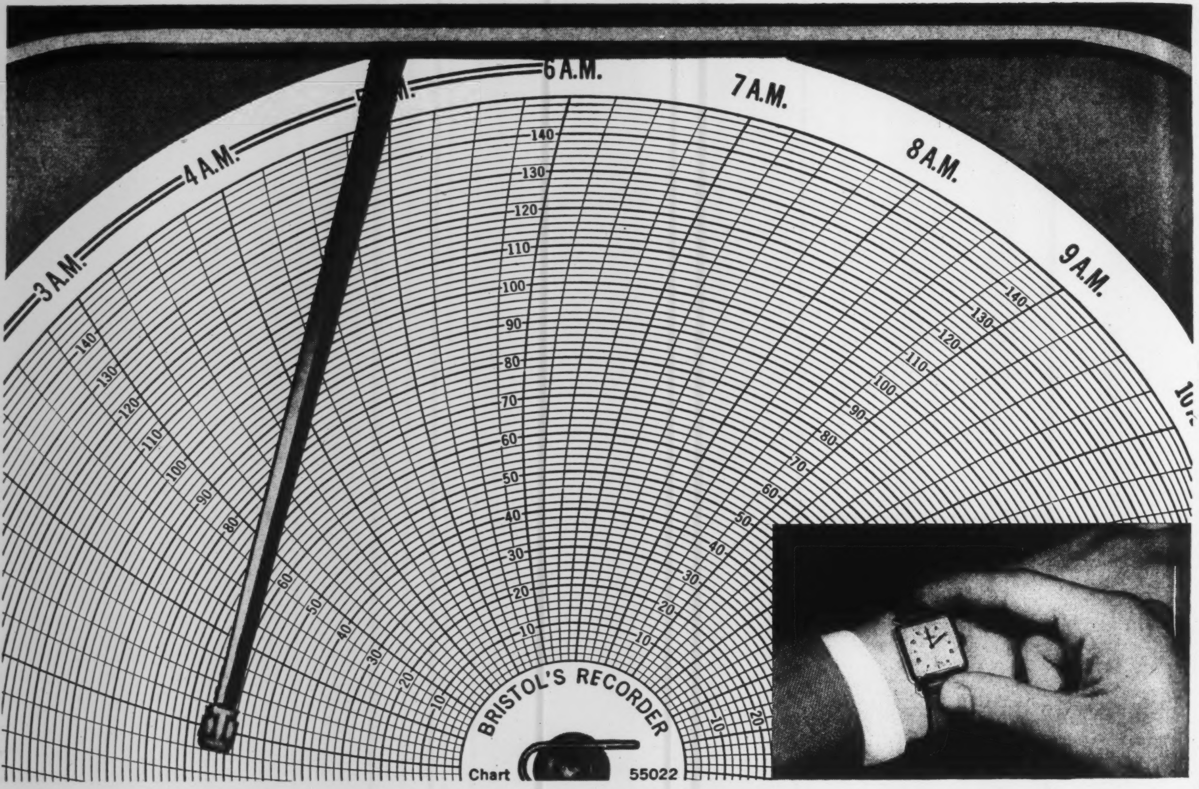
*Manufacturing Engineers*

WITH THE EXCLUSIVE STEP-VALVE DESIGN

**MILTON ROY COMPANY**

1309 EAST MERMAID LANE, PHILADELPHIA 18, PA.

CONTROLLED VOLUME PUMPS AND AUTOMATIC CHEMICAL FEED SYSTEMS


3 A.M.
4 A.M.
6 A.M.
7 A.M.
8 A.M.
9 A.M.
140
130
120
110
100
90
80
70
60
50
40
30
20
10
BRISTOL'S RECORDER
Chart
55022

***No watch can be more accurate than its dial . . .***

# No recorder can be more accurate than its chart!

Only BRISTOL
made-to-mea
for BRISTOL recorders!

For accuracy's sake, insist on Bristol charts for your Bristol recorders.

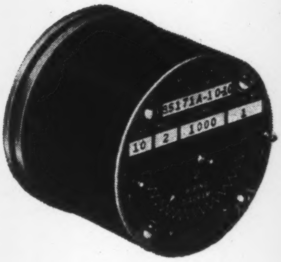
The chart is the scale that marks the recorder's measurements. Since only Bristol knows what those measurements are, only Bristol can make charts to record them accurately.

Bristol charts *do not* contain fillers, which cause poor inking, pen failure.

If you use a sizable quantity of Bristol charts a year, ask about our Chart Purchase Plan for savings up to 50%. Address The Bristol Company, Chart Division, 113 Bristol Road, Waterbury 20, Conn.

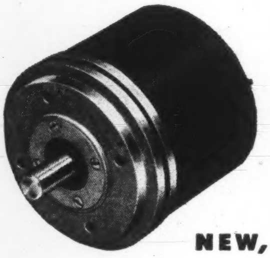
**BRISTOL** *The dependable Guidepost of Industry*

**AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS**



# unlimited resolution

(ZERO INCREMENT)



**NEW,**

**REVOLUTIONARY,**

**UNIQUE**

# spiralpot

## MULTI-TURN SLIDE WIRE POTENTIOMETER

Here is a multi-turn slide wire potentiometer that fulfills a long-felt need among users of precision potentiometers.

Designed specifically for applications requiring high resolution such as servo-control, computers, etc., it is available with angular shaft displacements up to 3600° Due to the unique slide wire arrangement which allows the brush to traverse the length of a single resistance wire as the shaft is rotated, resolution (zero increment) is unlimited. The "Spiralpot" is small, with a low noise level, exceptional linearity, low torque and long operating life.

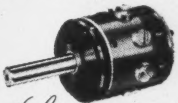
The electrical output is exactly proportional to angular shaft position.

*Write for further information*

### OTHER GIANNINI POTENTIOMETERS

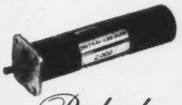
**Microtorque**

Ultra low torque, linear and functional output. .003 in. oz. torque, 250 to 25000 ohms, .031" dia. shaft 1.000" Diameter x 1.31" long.



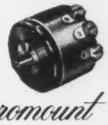
**Syncromount**

Linear and functional outputs. Ball bearings: ¼" shaft, 0.1 oz.-in. torque. 500 to 100,000 ohms. 1.125" diameter x 1.16" long.



**Rectipot**

Straight-line motion along axis. Linear or functional output. 200 to 60,000 ohms. 5 sizes, 1" diameter from 2.33" to 6.54" long. Stroke 1/5" to 5"

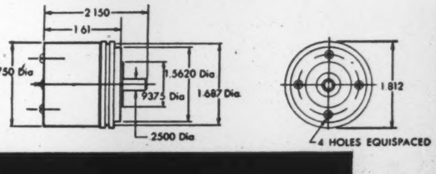


**Syncromount Jr.**

Linear and functional outputs. .078" dia. shaft—miniature ball bearings. ⅞" diameter x ⅞" long, .01 oz.-in. torque. 500 to 100,000 ohms.

**SPECIFICATIONS:**

**POSITIVE MECHANICAL STOPS** — withstands 500 oz.-in. torque.
**SHAFT ROTATION:** Up to 3600° plus 20° overtravel.
**RESISTANCE:** From 50 to 250 ohms per shaft revolution (from 500 to 2500 ohms for a 3600° unit).
**ACCELERATION:** Will meet specifications during 50G steady state acceleration along any axis.
**VIBRATION:** Withstands 10G sinusoidal vibration from 10 to 100 cps in all axes, and 10G in selected axes up to 200 cps.
**OPERATINGTEMPERATURE:** From −55° to +71° C.
**STARTING TORQUE:** Less than 2 oz.-in.
**BACKLASH:** None.
**LIFE:** Over one million revolutions.
**POWER:** 2 watts at +71° C.
**WEIGHT:** 4 oz.
**RESOLUTION:** Unlimited (zero increment).
**LINEARITY:** Standard model 0.1%.



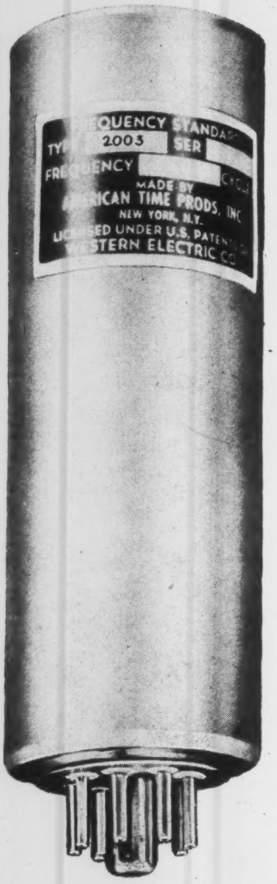
**Giannini** INSTRUMENT QUALITY POTENTIOMETERS

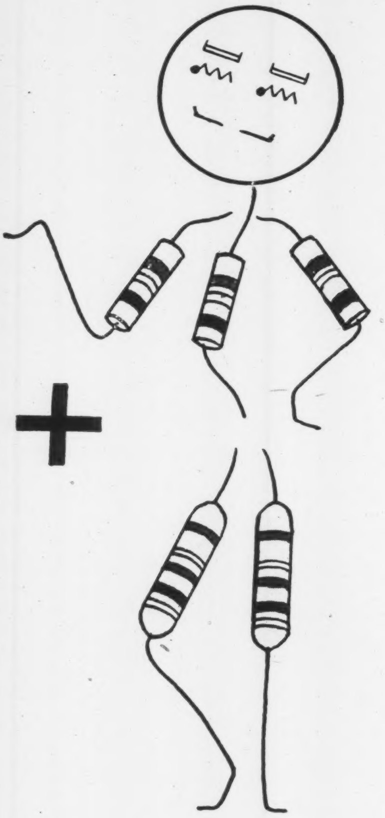
G. M. GIANNINI & CO. INC., PASADENA 1, CALIFORNIA—EAST ORANGE, NEW JERSEY

# *The* PERFECT *Wedding*

## TYPE 2003 FREQUENCY STANDARD

*The Type 2003 contains, in addition to the tuning fork, all circuit components which are selected or critical.—The tube and remaining components — three resistors and two .01 capacitors — are external and can be laid out and integrated with your equipment.*


FREQUENCY STANDARD
TYPE 2003 SER
FREQUENCY CYCLES
MADE BY
AMERICAN TIME PRODS, INC
NEW YORK, N.Y.
LICENSED UNDER U.S. PATENTS OF
WESTERN ELECTRIC CO.



**TUNING FORK STANDARD,** hermetically sealed.

**SIZE** — 4½ inches long. 1½ inches diameter.

**SIMPLE EXTERNAL CIRCUIT,** 1 tube, 3 resistors, 2 capacitors.

**TUBE** — Choice of 12AT7, 6201, 5751, 6BF7, 6BG7 or 6021.

**POWER REQUIRED,** 75 to 300 V at 1 to 5 m.a. — 6.3 V at 300 or 350 m.a.

**AVAILABLE** — in 400 or 500 cycles

**ACCURACY** guaranteed to .002%, 15° to 35° C.

*Write for descriptive literature, specifying Type 2003.*

*Also TYPE 2007*

(4½" x 1½")

COMPLETELY SELF-CONTAINED
INCLUDING VACUUM TUBE

*Manufacturer of high precision frequency and timing instruments controlled by tuning fork oscillators.*

# *American Time Products, Inc.*

***580 Fifth Avenue*** ***New York 36, N. Y.***

OPERATING UNDER PATENTS OF THE WESTERN ELECTRIC COMPANY

News

# Design, Application, Operation of Flow Indicators Described In New Bulletin

18W
Flow
Indicators

Bulletin 18-W, illustrated at left, contains complete information on the many types of Flow Indicators manufactured by SK.

Flow Indicators, installed in pipelines, permit visual observation of fluid flow, direction of flow and flow conditions. These indicators are widely used throughout industry to prevent damage to valuable equipment.

SK Flow Indicators are suitable for service with any kind of fluid—liquid, gas, vapor, slurry, or sludge—provided the fluid is transparent enough to permit observation. They are designed to operate continuously—even under severe operating conditions—with minimum maintenance.

Request a copy of Bulletin 18-W for your files. It's a useful 12 page reference source.

SCHUTTE AND KOERTING COMPANY

SK FLOW INDICATORS

SK Flapper Type, Single Sight Glass Flow Indicator, Fig. 1801

SK Flapper Type, Double Sight Glass Flow Indicator, Fig. 1802

**Details on SK FLOW INDICATORS incorporated in BULLETIN 18-W include:**

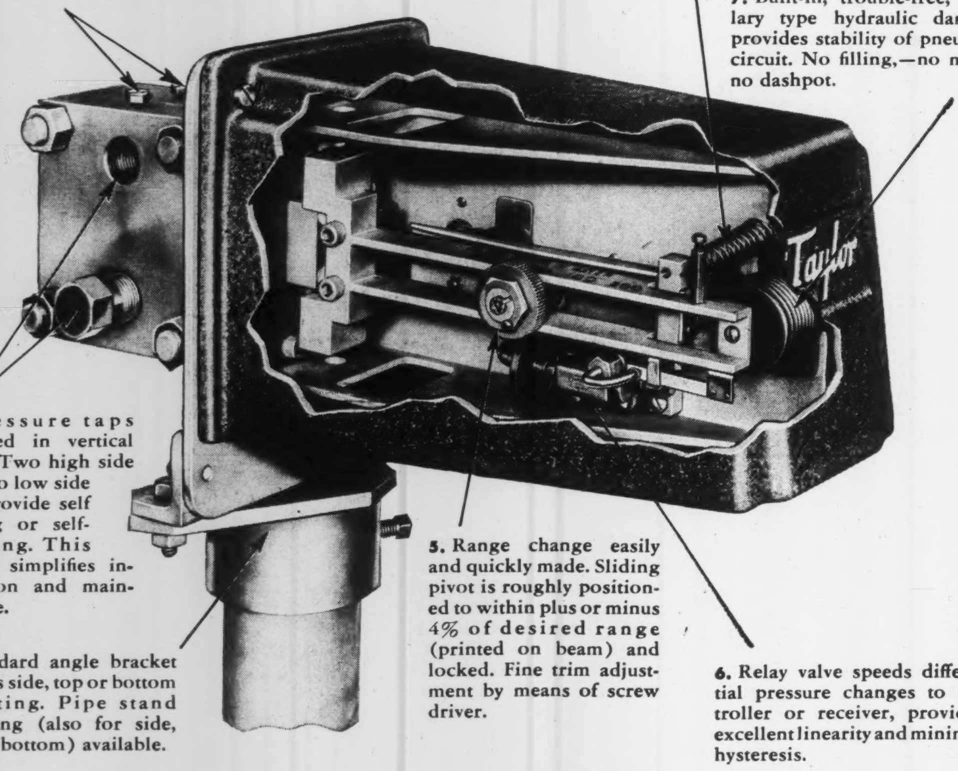
- **Design and construction features**
- **Materials of construction**
- **Tables of operating pressures, temperatures, dimensions**
- **Operating data**
- **Performance curve charts**
- **Ordering specifications**

**NOTE:** *For information on SK Rotameters, accurate fluid flow measuring instruments, request Bulletin 18-RA which pictures and briefly describes the many types manufactured by SK.*

*Manufacturing Engineers*

# New **TRANSAIRE**®

## The new Taylor TRANSAIRE® Differential Pressure Transmitter



**1.** Dry meter operates on force-balance principle. Diaphragm of Teflon coated glass cloth. Body working pressure rating 1500 psi. Available in either forged steel or type 430 stainless steel.

**2.** Vent screws to provide for total filling in liquid service.

**3.** Pressure taps mounted in vertical plane. Two high side and two low side taps provide self venting or self-draining. This feature simplifies installation and maintenance.

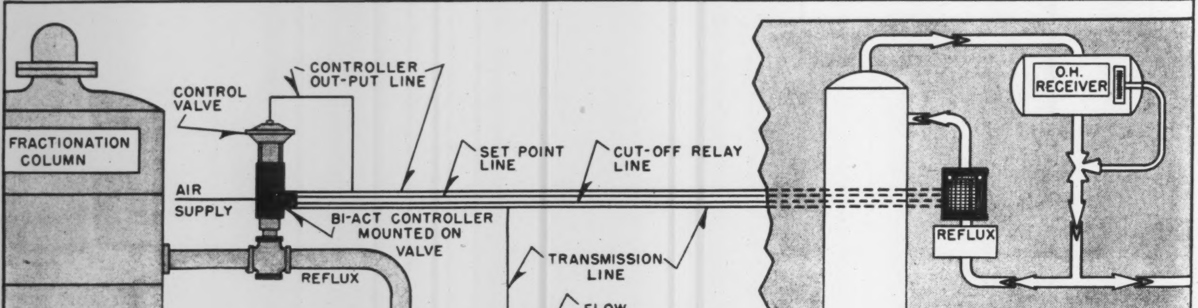
**4.** Standard angle bracket permits side, top or bottom mounting. Pipe stand mounting (also for side, top or bottom) available.

**5.** Range change easily and quickly made. Sliding pivot is roughly positioned to within plus or minus 4% of desired range (printed on beam) and locked. Fine trim adjustment by means of screw driver.

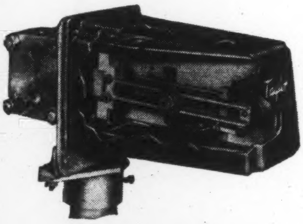
**6.** Relay valve speeds differential pressure changes to controller or receiver, providing excellent linearity and minimum hysteresis.

**7.** Built-in, trouble-free, capillary type hydraulic damping provides stability of pneumatic circuit. No filling,—no mess—no dashpot.

**8.** Provision for adjustment of range suppression up to 100%.


FRACTIONATION COLUMN
CONTROL VALVE
CONTROLLER OUT-PUT LINE
SET POINT LINE
CUT-OFF RELAY LINE
AIR SUPPLY
BI-ACT CONTROLLER MOUNTED ON VALVE
REFLUX
TRANSMISSION LINE
ORIFICE
FLOW TRANSMITTER
AIR SUPPLY
O.H. RECEIVER
REFLUX
GRAPHIC PANEL CONTROL

# Flow Transmitter widens selection of Taylor Transmitters!



THIS new Taylor Transmitter is the result of extensive field study and close collaboration with users of force-balance transmitters. It is designed to meet present day industrial requirements for a rugged, dependable and accurate instrument to measure flow, liquid level or specific gravity. With this new development three force-balance transmitters are now available for the measurement and transmission of flow, temperature and pressure.

### INEXPENSIVE AND SIMPLE TO INSTALL

• Simplified piping because it can be close coupled to orifice flanges. • No seal pots required—negligible displacement because of force-balance construction. • No leveling—mercuryless dry meter. • Light weight for easy handling; weighs only 23 lbs.

### ECONOMICAL, EASY TO MAINTAIN

• Self draining or venting—no periodic manual venting or draining. • Overrange protection to full body rating.

### ACCURATE

• Relay valve for linearity, minimum hysteresis, fast speed of response. • Pressure effect 0.2% / 100 psi. change. • Temperature effect 1.0% / 100°F. change.

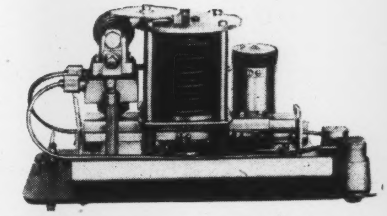
### RUGGED AND DEPENDABLE

• Weatherproof housing built for tough service and outdoor mounting. • Force-balance construction; negligible motion; minimum possible wear. • Process sealing bellows 3 ply type 316 stainless steel.

▼ ▼ ▼

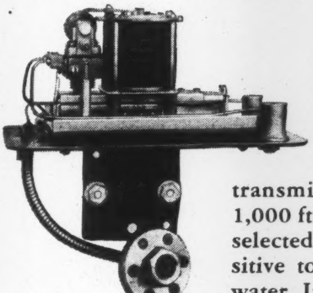
**Ask your Taylor Field Engineer** for full details of this new Taylor TRANSAIRE Differential Pressure Transmitter, or write for **Bulletin 98226.** Taylor Instrument Companies, Rochester, N.Y., and Toronto, Canada.

*Instruments for indicating, recording and controlling temperature, pressure, flow, liquid level, speed, density, load and humidity.*



### TAYLOR TRANSAIRE TEMPERATURE TRANSMITTER

With Speed-Act. This is a compact, super-responsive instrument designed to measure and transmit smallest temperature changes up to 1000 ft. with great accuracy. It gives you: • Unprecedented speed of response provides dynamic accuracy thanks to derivative action (Speed-Act) in the *measuring* circuit. • It will transmit an output pressure proportional to the measured temperature with an accuracy of plus or minus 0.06 psi.



### TAYLOR TRANSAIRE PRESSURE TRANSMITTER

A highly sensitive and accurate suppressed pressure measuring instrument, designed to measure and transmit pressure changes up to 1,000 ft. It is accurate to ½% of the selected short range span and sensitive to pressure changes of ½″ water. It gives you these important advantages: • Short range spans available 20 to 40 psi. throughout range limits of 35 to 415 psia, and 50 to 100 psi. throughout 100 to 1,000 psia. • Volumetric type pressure system is extremely accurate, practically clog-proof, has corrosion resistant 316 stainless steel diaphragm. • Temperature and barometric compensation for higher accuracy of measurement and control.

*Taylor Instruments*

**MEAN**

**ACCURACY FIRST**

**IN HOME AND INDUSTRY**

# *Combined for Service and Savings:*

# AUTOMATIC CONTROL

# *and* INSTRUMENTATION

## by HAGAN

Hagan Engineers have developed automatic control equipment and instruments which can be assembled into coordinated systems designed to meet your particular requirements. For example:

**HAGAN AIR-OPERATED AUTOMATIC CONTROL EQUIPMENT** includes pressure measuring and control units which may be combined into automatic control systems for process industries, metallurgical furnaces and steam power plants.

**HAGAN RING BALANCE FLOW METERS** are the most versatile meters available. Hagan Meters indicate, record, and integrate one or two flow rates. Standard modifications provide for pressure and temperature compensation. Ring assemblies are available to measure pressure differentials from 20" to 140" WC at static pressures up to 15,000 psig, and from 40" to 420" WC at static pressures to 3000 psig.

**THE SPECIAL APPLICATION DIVISION** is equipped to design and fabricate force measuring devices and coordinated control and metering systems for aeronautical testing facilities, and for automotive and process plants. Examples include automatic control of simulated flight conditions in supersonic wind tunnels and altitude test chambers, control systems for gas turbines, thrust stands for full power test of planes, dynamometer testing and automatic batch weighing.

**WRITE, WIRE or PHONE** today for information about how Hagan Engineers can help you solve your industrial control and instrumentation problems.

**HAGAN CORPORATION**

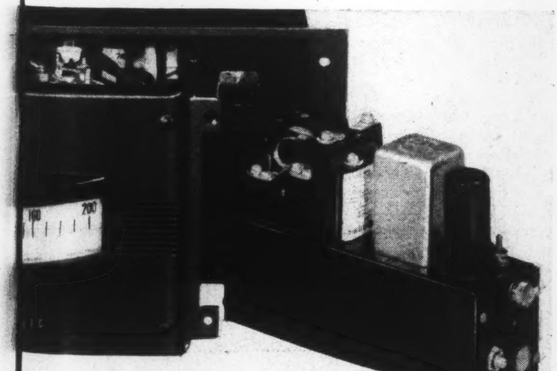
HAGAN BUILDING
PITTSBURGH 30, PENNSYLVANIA

BOILER COMBUSTION CONTROL SYSTEMS
RING BALANCE FLOW AND PRESSURE INSTRUMENTS
METALLURGICAL FURNACE CONTROL SYSTEMS
CONTROL SYSTEMS FOR AERONAUTICAL
AND AUTOMOTIVE TESTING FACILITIES

HAGAN
HALL
BUROMIN
CALGON

OPERATOR RESETTING PROTECTOR UNIT OF A TYPE HP-3 PYROMETER PROTECTOR WHICH IS USED TO PROTECT A DRY-MOLDING OVEN.

# G-E Pyrometers Protect Sand Molds from Overheat Damage in Eastern Iron Foundry



**PROTECTOR UNIT** is readily accessible for maintenance checks. Merely remove cover and pull out. Standard oscillator tube is shown above on right end of unit.

A large eastern iron foundry is currently using two General Electric Type HP-3 pyrometers as protectors for their dry-molding ovens to prevent ovenheat damage to sand molds. In the event of a controller failure that would allow the temperature of the ovens to increase, these protectors immediately shut down the oven, thus saving the molds in process.

**RESISTANCE TO VIBRATION** of these G-E pyrometers is essential in this operation. Roll-over rammer machines, used for pressing sand into core boxes, and an overhead crane are located nearby. Yet, the pyrometers have operated continuously, with only normal servicing, since they were installed.

**LOWER MAINTENANCE EXPENSE** is also obtained from G-E pyrometer equipment. The plug-in protector unit and standard oscillator tubes are features which permit easy maintenance and cut replacement time.

**MORE INFORMATION** available from your G-E representative, or write for Bulletin GEC-713. G.E. also offers a complete line of resistance thermometers—described in GEC-835. Write Section 602-247, General Electric Co., Schenectady 5, N. Y.

**GENERAL ELECTRIC**

# The new Du Mont Type 304-A

## A TRUE cathode-ray voltmeter

# AT THE PUSH OF A BUTTON...

Once you zero-set a new Du Mont Type 304-A it is almost automatic to measure potentials of the waveforms on the screen of the cathode-ray tube. And you'll be surprised to find out how much more you know about your circuit; how much easier circuit development and production testing become when amplitude calibration is in front of you every time you examine a waveform. The new Du Mont Type 304-A will make your job easier, will greatly simplify measurements that formerly were difficult or inconvenient to make. The Type 304-A is not just another oscillograph; it is a true cathode-ray voltmeter, made possible by a precision calibrator and the tight-tolerance, flat-face Type 5ADP- Cathode-ray Tube. Only through the combined facilities, unique in the industry, of the Du Mont Cathode-ray Tube and Instrument Divisions could the Type 304-A Cathode-ray Oscillograph have evolved.

**SPECIFICATIONS:**

- Tight-tolerance, flat-face Type 5ADP- Cathode-ray Tube
- Vertical and horizontal amplifiers flat to d.c., 10% down at 100 KC
- Direct voltage measurement — Range, 0.1 to 1000 volts full scale, read directly from oscillograph scale; 5% overall accuracy
- High sensitivity — At full gain, 0.025 volts/inch
- Undistorted vertical and horizontal deflection more than 4 inches
- Expansion equivalent of 20 inches vertically and 30 inches horizontally with full positioning
- Driven and recurrent sweeps with sync limiting — Range, 2 to 30,000 cps; provision for extra-low frequency sweeps by externally connected capacitor; maximum writing rate, 1 inch/µsec
- Illuminated, numbered scale and suitable filter provided; scale illumination variable from zero to more than adequate for viewing and photography
- Improved stability of vertical amplifier

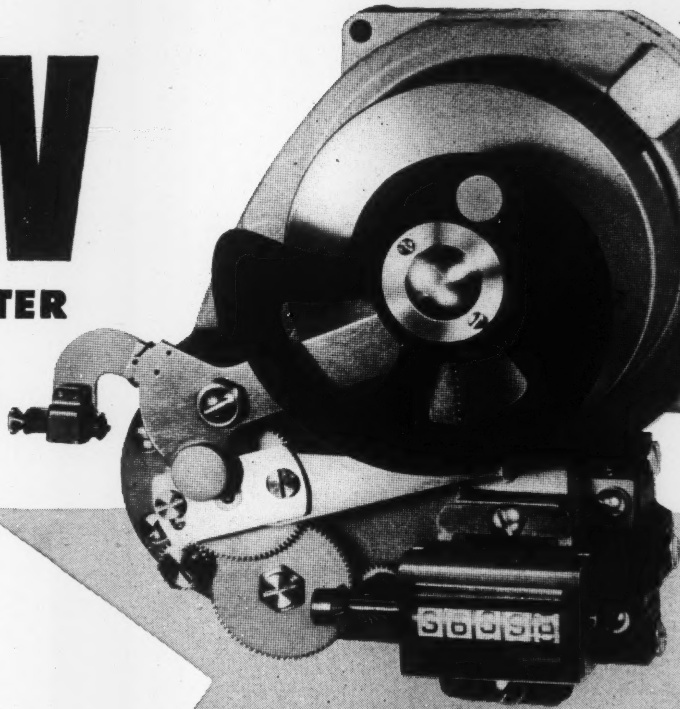
**Price** ........................................................ **$333.00**

**DU MONT**

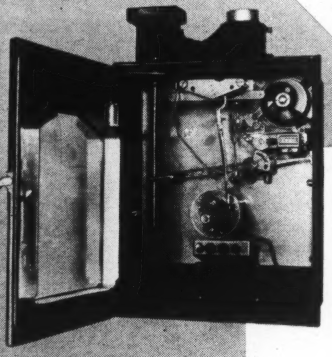
INSTRUMENT DIVISION, ALLEN B. DU MONT LABORATORIES, INC., 1500 MAIN AVE., CLIFTON, N. J.

# new

## FISCHER & PORTER
## FLOW RATE
## INTEGRATOR



New . . . and providing a degree of precision never before approached — *plus* Fischer & Porter adherence to quality of design and components . . . the new 1600 Series Integrator merits your careful analysis.



*Complete information on the new Series 1600 Integrator is yours for the asking.*

*Measure these outstanding benefits:*

1. High speed—only 2½ seconds between counts. Follows rapid fluctuations in input signal with highest fidelity.
2. Motor drive — GE type SMY, low speed synchronous motor — absolutely unique in this field.
3. Standard or explosion proof available from stock.
4. Completely enclosed mechanism—new die-cast aluminum case built to meet unusual dust tight, vapor tight, waterproof or explosion proof requirements.
5. All mechanisms completely enclosed, permanently lubricated.
6. Mechanical accumulator — unique F & P design of an infinitely variable roller clutch and reverse brake mechanism, magnetically loaded eliminating springs and friction. Entire mechanism oil immersed for permanent cleanliness, lubrication, and freedom from wear and corrosion.
7. Motor drive gears and overtravel crank enclosed and permanently lubricated with silicone instrument grease.
8. New counter — clearly visible — no peep holes.
   — available with predetermining counters for limiting process quantities.
   — available with reset, remote electric repeater counters.
9. Input cams available for linear, square root or fractional power flow or other functions.

**FISCHER & PORTER COMPANY**

1420 COUNTY LINE ROAD, HATBORO, PENNA.

⊕1854-R

*Here's why* it pays to know your

**HSM**

HONEYWELL SUPPLIES MAN

C. J. SMOLINSKE, Honeywell Supplies Man in the Indianapolis area, helps check connections of special purpose thermocouple wire on a jet engine test in the CAA Laboratories, Indianapolis. Highly useful in this and many other applications are the new thermocouple wires recently added to the ever-expanding line of Honeywell supplies. An exceptionally wide range of temperature is now covered by new wires with the following insulations: plasticized vinyl chloride insulation for service from —20 to 225° F.; non-impregnated glass insulation for use up to 1200° F.; and fibrous silica insulation for temperatures as high as 2000° F.

Special purpose wires are but one part of the complete supplies service afforded by the HSM Plan. In literally hundreds of ways, this plan can add new convenience and economy to *all* your pyrometer supplies buying!

Find out now, how planned buying—*the HSM way*—can assure you the best in quality, availability and price. Your local Honeywell Supplies Man will be glad to explain how this plan can work for you. Call him today . . . he is as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4583 Wayne Ave., Philadelphia 44, Pa. Stocking points in Philadelphia, Cleveland, Chicago, Atlanta, Houston, Los Angeles and San Francisco.

H
HONEYWELL

● *Important Reference Data*

**Write for new Pyrometer Supplies Buyer's Guide No. 100-4**

MINNEAPOLIS
**Honeywell**
BROWN INSTRUMENTS

*First in Controls*

You're sighting on the moose through a Weaver Scope, made by W. R. Weaver Company, El Paso, Texas

# The Superior Tube That Puts You "On Target"

Hitting specification bull's-eyes to help our customers hit their production targets is a Superior specialty.

A case in point is illustrated above. The customer, W. R. Weaver Company manufactures high-quality telescopic sights for sporting and target rifles. The carbon steel tube in which the lens elements, reticule and eye piece are mounted must be strong and rigid. Tube material must have excellent machining qualities to permit fast, economical, precision working. Because salability depends a good bit on fine appearance, the tube must be extremely smooth and free from pits and scratches. This is particularly true of the larger sizes where tube ends are expanded, making imperfections more evident. Inside surface must also be smooth and to accurate dimensions.

Ordinarily you might expect tubing to fit such requirements for smoothness plus temper and machinability would be a "premium" item carrying extra charges for special handling.

Not at Superior. Here we can take the most exacting specifications in stride because of our experience and "know-how" backed by highly developed production equipment and extensive research and testing facilities.

If you have need for fine, small tubing to do a tough job well, check with us. We can probably fill your requirements from the stocks of our distributors who are located in principal cities. Write Superior Tube Company, 1968 Germantown Ave., Norristown, Pennsylvania.

**BE SURE ABOUT TUBING—
SPECIFY**

**Superior**
THE BIG NAME IN SMALL TUBING

All analyses .010" to ⅝" O.D.
Certain analyses (.035" max. wall) up to 1⅝" O.D.
**ROUND AND SHAPED TUBING**

Available in:

**Carbon Steels:**
A.I.S.I.—C-1008, MT-1010, MT-1015, C-1118, MT-1020, C-1025, C-1035, E-1095

**Alloy Steels:**
A.I.S.I.—4130, 4132, 4140, 4150, 8630, E-52100

**Stainless Steels:**
A.I.S.I.—303, 304, 305, 309, 310, 316, 317, 321, 347, 403, 410, 420, 430, 446, T-5

**Nickel Alloys:**
Nickel, "D Nickel"*, "L Nickel"*, "Monel"*, "K Monel"*, "Inconel"*, 30% Cupro Nickel.

**Beryllium Copper:**

West Coast: Pacific Tube Company, 5710 Smithway St.,
Los Angeles 22, Calif. UNderhill 0-1331.

*Reg. U. S. Trademark
International Nickel Company

# Here's How *to Erase* Smoke Troubles

VIOLATION OF SMOKE ORDINANCE

LOSS OF FUEL ECONOMY

BAD COMMUNITY RELATIONS

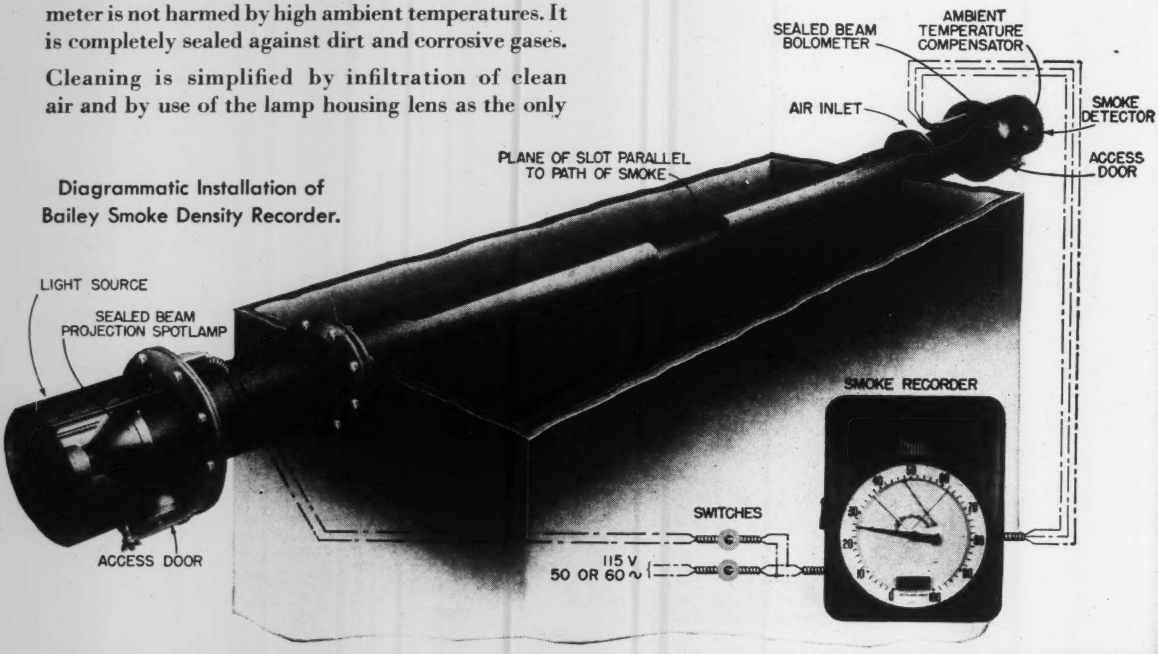
★ One of your first steps in erasing these troubles which result from excessive smoke, should be the installation of a Bailey Smoke Density Recorder. This 24-hour recorder is not an ordinary photo-cell instrument. Instead it detects smoke density by a Bolometer which is simply a sturdy tungsten filament and a parabolic mirror, mounted in a standard sealed beam automobile head lamp housing.

In using this simple, unique smoke detector, you do not have to provide cooling devices since the Bolometer is not harmed by high ambient temperatures. It is completely sealed against dirt and corrosive gases.

Cleaning is simplified by infiltration of clean air and by use of the lamp housing lens as the only window between the Bolometer and the gas passage.

It's easy to secure and maintain alignment of the sealed beam light source with the Bolometer since they are mounted at opposite ends of a slotted pipe which extends across the smoke passage.

For complete information on how you can profitably use this unique instrument to erase your smoke troubles, ask for Bulletin 211, "Bailey Smoke Density Recorder".


SEALED BEAM
BOLOMETER
AMBIENT
TEMPERATURE
COMPENSATOR
AIR INLET
SMOKE
DETECTOR
ACCESS
DOOR
PLANE OF SLOT PARALLEL
TO PATH OF SMOKE
LIGHT SOURCE
SEALED BEAM
PROJECTION SPOTLAMP
SMOKE RECORDER
SWITCHES
115 V
50 OR 60 ~
ACCESS DOOR

Diagrammatic Installation of Bailey Smoke Density Recorder.

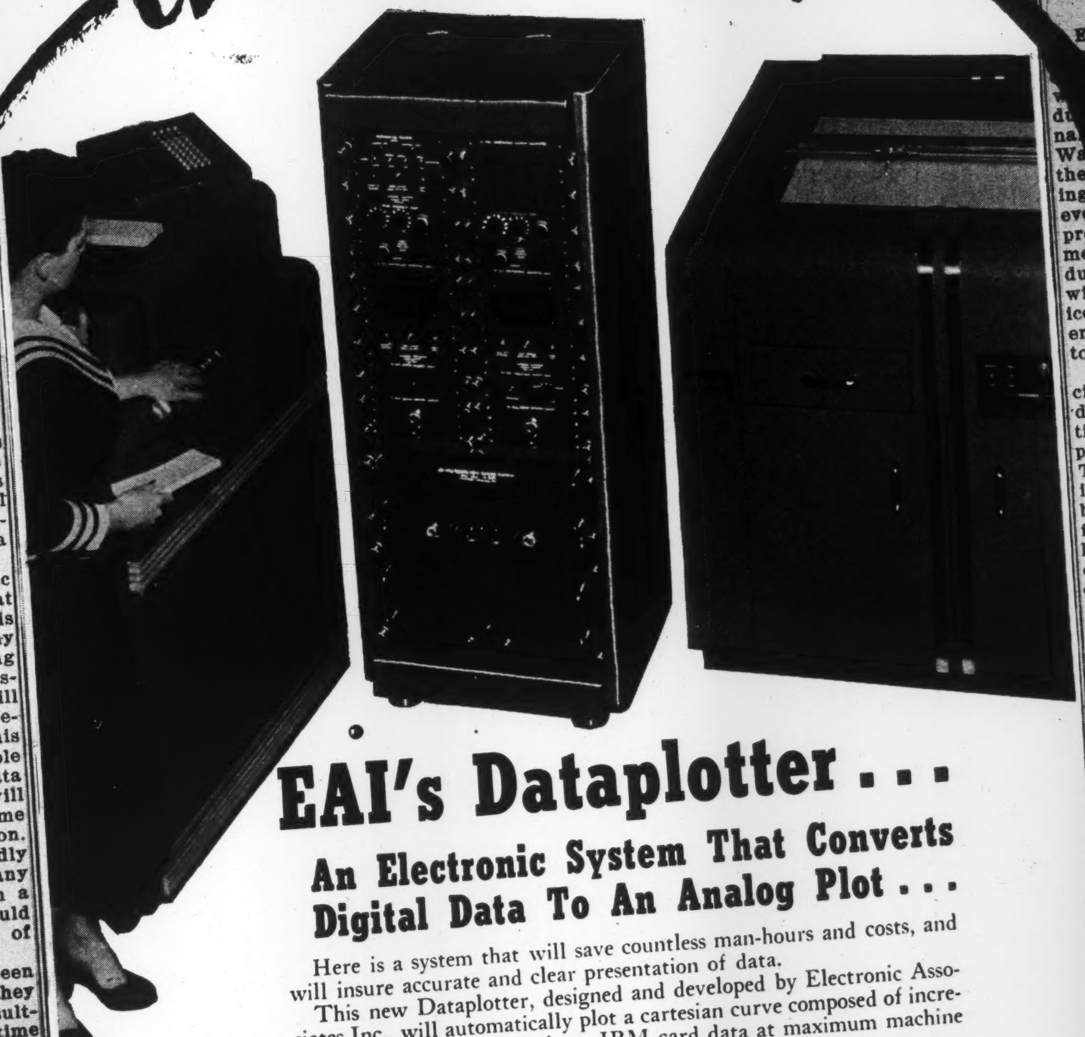
G-29

**BAILEY METER COMPANY**

1041 IVANHOE ROAD, CLEVELAND 10, OHIO • BRANCH OFFICES IN PRINCIPAL CITIES

BAILEY METER COMPANY LIMITED, MONTREAL, CANADA

*Let Bailey Smoke Density Recorders Watch Your Stacks*



# EAI's Dataplotter . . .

## An Electronic System That Converts Digital Data To An Analog Plot . . .

Here is a system that will save countless man-hours and costs, and will insure accurate and clear presentation of data.

This new Dataplotter, designed and developed by Electronic Associates Inc., will automatically plot a cartesian curve composed of incremental points or symbols from IBM card data at maximum machine reading speed.

It will accept data from other inputs — Magnetic tape, keyboards, digital computers, etc.

It will retain at all times the basic accuracy of the digital system.

Here's what the Dataplotter system consists of:

- Variplotter Model 205G
- Digital-to-analog converter, Model 417
- Data input keyboard

For further information, clip out and mail the coupon below. No obligation.

**ELECTRONIC ASSOCIATES** *Incorporated*

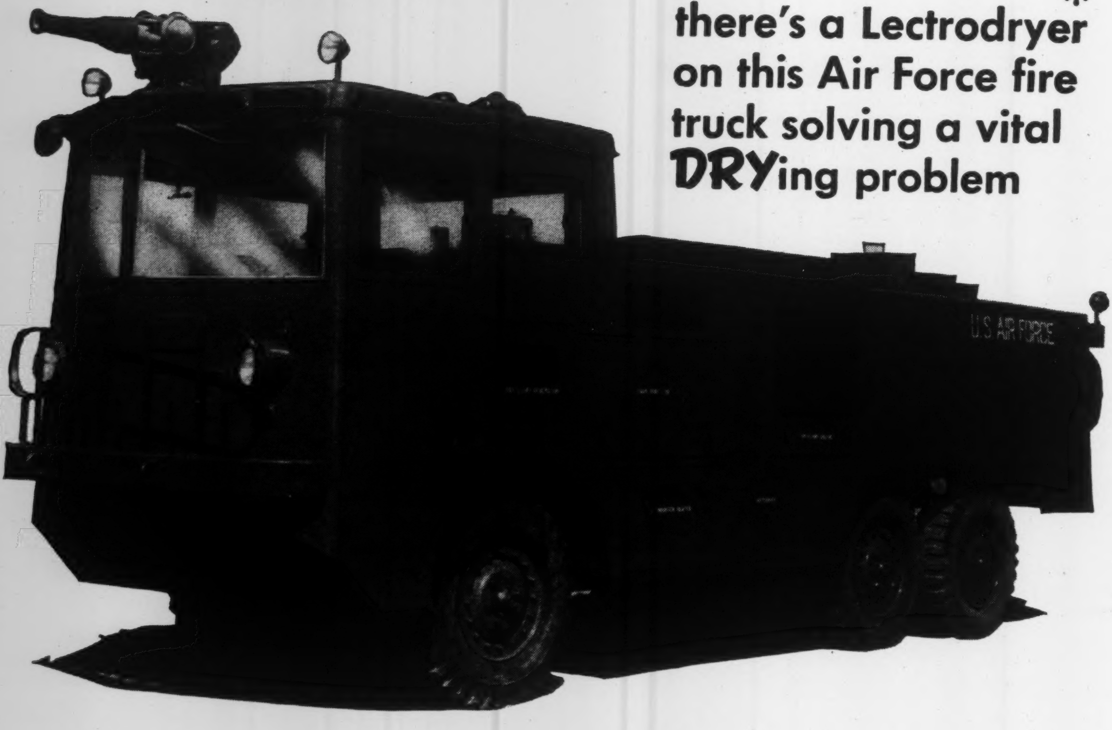
Electronic Associates Inc.
Long Branch
New Jersey

Gentlemen: Would you be kind enough to send me detailed information on your Dataplotter.

Name .................................................
Title ..........
Company ..........................................
Address ..............................................
City .......................
Zone .....
State ........

The story's RESTRICTED but

there's a Lectrodryer* on this Air Force fire truck solving a vital DRYing problem



Adding to the DEPENDABILITY of this equipment is Lectrodryer's role aboard this crash fire truck, just as it is throughout industry generally. A Lectrodryer removes unwanted moisture from air, gases and organic liquids to dewpoints below −110° F., thus helping to speed production and maintain high quality.

LECTRODRYER is the name of a large family of DRYing machines. They range in size from the tiny Laboratory Model, capable of handling a few cubic feet per hour, to giant wind tunnel installations handling tons of air per minute. They work at atmospheric pressure or as much as 5,000 psi., manually or automatically controlled.

Lectrodryer engineers can advise you on the DRYing equipment you'll need for any job, basing their recommendations on nearly twenty years' experience in DRYing. No need for your men to take valuable time on such problems. For this help, write Pittsburgh Lectrodryer Corporation, 330 32nd Street, Pittsburgh 30, Pennsylvania.

In England: Birlec, Limited, Tyburn Road, Erdington, Birmingham.
In Australia: Birlec, Limited, 51 Parramatta Road, Glebe, Sydney.
In France: Stein et Roubaix, 24 Rue Erlanger, Paris XVI.
In Belgium: S. A. Belge Stein et Roubaix, 320 Rue du Moulin, Bressoux-Liege.

LECTRODRYERS DRY WITH ACTIVATED ALUMINAS

LECTRODRYER

*REGISTERED TRADEMARK U.S. PAT. OFF.

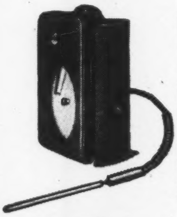
# CHECK THESE 3 WAYS YOU CAN SAVE WITH THIS MULTI-PURPOSE INSTRUMENT

Here is the most sensible idea you've ever seen in a recorder or controller—an instrument you can change as your instrument needs change, that you can add to, subtract from, or whose functions you can increase or decrease at little or no expense.

- ✓ **Save money when you add new functions by adding only those new assemblies needed.**
- ✓ **Save time-delays by making changes on the job site without returning to factory.**
- ✓ **Save money on inventory. Parts are interchangeable, fit all Gotham Convertible recorders. You can service a whole group with a minimum stock of basic elements.**

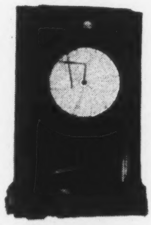
## What you can do with the Gotham Convertible

**Depending on the chart size of the recorder (6″, 9″ or 12″) you can have a 1-2-3 or 4 pen recorder with 14 pressure, temperature and time operation combinations or a recorder-controller with 38 possible pressure, temperature, and time combinations.**



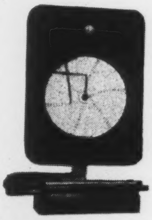
### *SELF-CONTAINED PORTABLE RECORDER*

**A portable recorder which has a carrying handle, legs and retaining holder for capillary and bulb. Built from Gotham standard elements, interchangeable with other Gotham instruments. 6", 9" and 12" chart sizes. Mercury, Vapor or Pressure Activated. Spring or electric chart drive. See Catalog 400.**



### *RECORDING PSYCHROMETER*

**Incorporates the same highly accurate and responsive thermal systems and contains all other Gotham standard convertible features. Wet and dry bulb type. Motor-driven suction fan. 12" chart size. Catalog 400.**



### *RECORDING HYGROMETER*

**A 2-pen recorder of the wet and dry bulb type. Mercury or Vapor Actuated. 9" and 12" chart sizes. Available with variety of wet and dry bulb assemblies depending on application. Catalog 400.**

**GOTHAM INSTRUMENTS**

*Keep everything under control with Gotham*

**GOTHAM INSTRUMENTS**
**Division of American Machine and Metals, Inc.**
**Dept. 2, 233 Broadway**
**New York 12, New York**

**Please send me a copy of your**

- ☐ Catalog 100—Industrial Thermometers
- ☐ Catalog 200—Dial Type Thermometers
- ☐ Catalog 400—Recorders, Psychrometers, Hygrometers
- ☐ Catalog 500—Controllers
- ☐ Have your representative call. No obligation.

Name________________ Title________

Company________________

Address________________

City__________ Zone____ State______

# *New* POTTER *Industrial* FLOWMETER

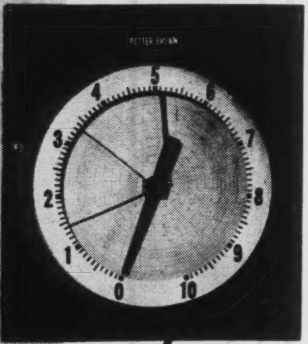
# Accurately measures fluids and gases—*Even under difficult conditions*

The new Potter-Brown Electronic Flowmeter is an industrial instrument with the high accuracy and dependability required for laboratory work. The unit handles toxic and highly corrosive materials at pressures up to 20,000 psi and temperatures from 4° absolute to 1,200°F. Installation directly in the flow line is simple and inexpensive. An unusual design feature eliminates bearing maintenance, friction drag, and high pressure drop.

The Potter-Brown Flowmeter comprises a flow-sensing unit having a hydraulically balanced rotor and magnet rotating within a compact non-magnetic housing fitted with an external pickup coil, and means for measuring, controlling, and indicating the flow at one or more locations.

## *Features*

- ***Accurate within ±½%***
- ***Low pressure drop***
- ***No thrust bearing***
- ***Simple installation***
- ***Linear characteristics***
- ***Integral calibration***
- ***Specific gravity compensation adjustment***



## ACCURATE within ±½%

The Potter design causes fluid flow through the unit to establish upstream thrust components which exceed the downstream drag on the rotor. This enables the rotor to spin freely without friction in a "no-slip" condition within its rated capacities. Accuracy is maintained within ± ½ %. Fluid viscosity, pressure, temperature, and specific gravity only slightly affect the volumetric flow rate.

**SPECIFICATIONS**

| Sensing Element Size | Contg. Tube, Size | Over-all Length | Hex. | Height (incl. coil) | Weight in Stainless Steel | Weight in Aluminum | Range, gpm |
|---|---|---|---|---|---|---|---|
| 3/16" | 3/8" | 2 7/16" | 13/16" | 1 3/4" | 5 oz. | 2 1/2 oz. | .09-.7 |
| 3/8" | 3/8" | 2 7/16" | 13/16" | 1 3/4" | 5 oz. | 2 1/2 oz. | .2-2.0 |
| 1/2" | 1/2" | 2 7/16" | 13/16" | 1 3/4" | 5 oz. | 2 1/2 oz. | .9-9 |
| 5/8" | 5/8" | 2 7/16" | 1 1/8" | 2 1/8" | 7 oz. | 3 1/2 oz. | 1-12 |
| 3/4" | 3/4" | 3 1/4" | 1 3/8" | 2 5/16" | 12 oz. | 5 oz. | 1 1/2-20 |
| 1" | 1" | 3 1/2" | 1 5/8" | 2 9/16" | 22 oz. | 10 oz. | 2-40 |
| 1 1/4" | 1 1/4" | 3 7/8" | 1 7/8" | 2 13/16" | 28 oz. | 13 oz. | 3 1/2-90 |
| 1 1/2" | 1 1/2" | 4 3/8" | 2 1/8" | 3 1/16" | 37 oz. | 16 oz. | 6-125 |
| 2" | 2" | 4 3/4" | 2 3/4" | 3 11/16" | 48 oz. | 20 oz. | 10-250 |

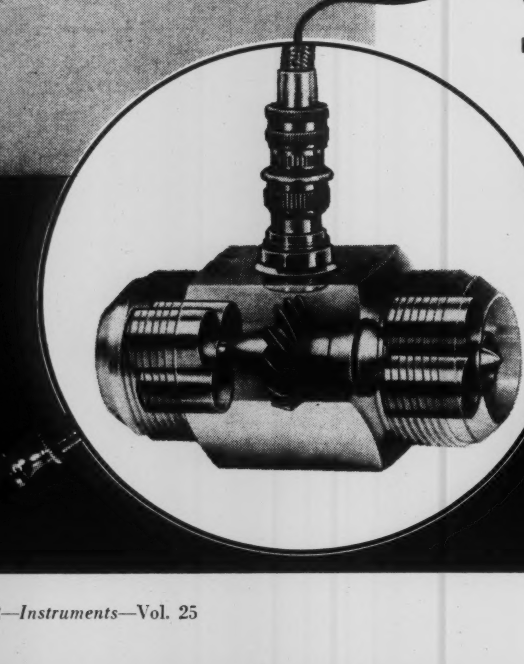
## Operation

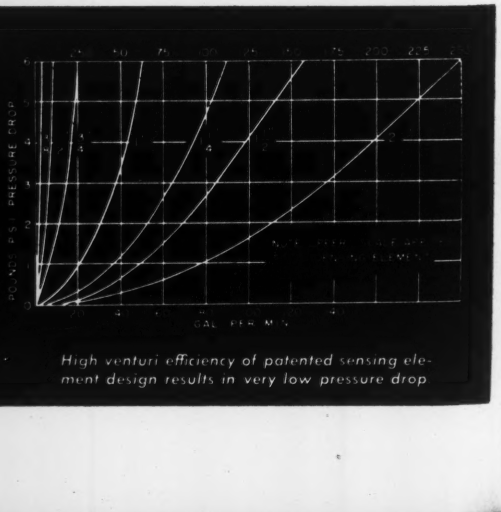
Electric impulses generated by the magnet within the sensing element rotor are transmitted by the pickup coil to a converter which delivers dc voltage output proportional to the ac frequency of the sensing element. A potentiometer measures and records the dc output as flow.

For measuring fluids of varying specific gravities and for recording, indicating, and totalizing flow in weight units, a unit with specific gravity adjustment is available, which allows accurate setting of the instrument to compensate for density variations.

We will gladly help you solve your flow measuring problems. Send for new bulletin.

**POTTER AERONAUTICAL COMPANY**
**87 Academy Street, Newark 2, N. J.**





*High venturi efficiency of patented sensing element design results in very low pressure drop*

# For *Critical* Applications

## Triplett 630-A Has No Counterpart

*Accuracy*
**to 1½%**

*Readability*
**with a Mirror-Scale**

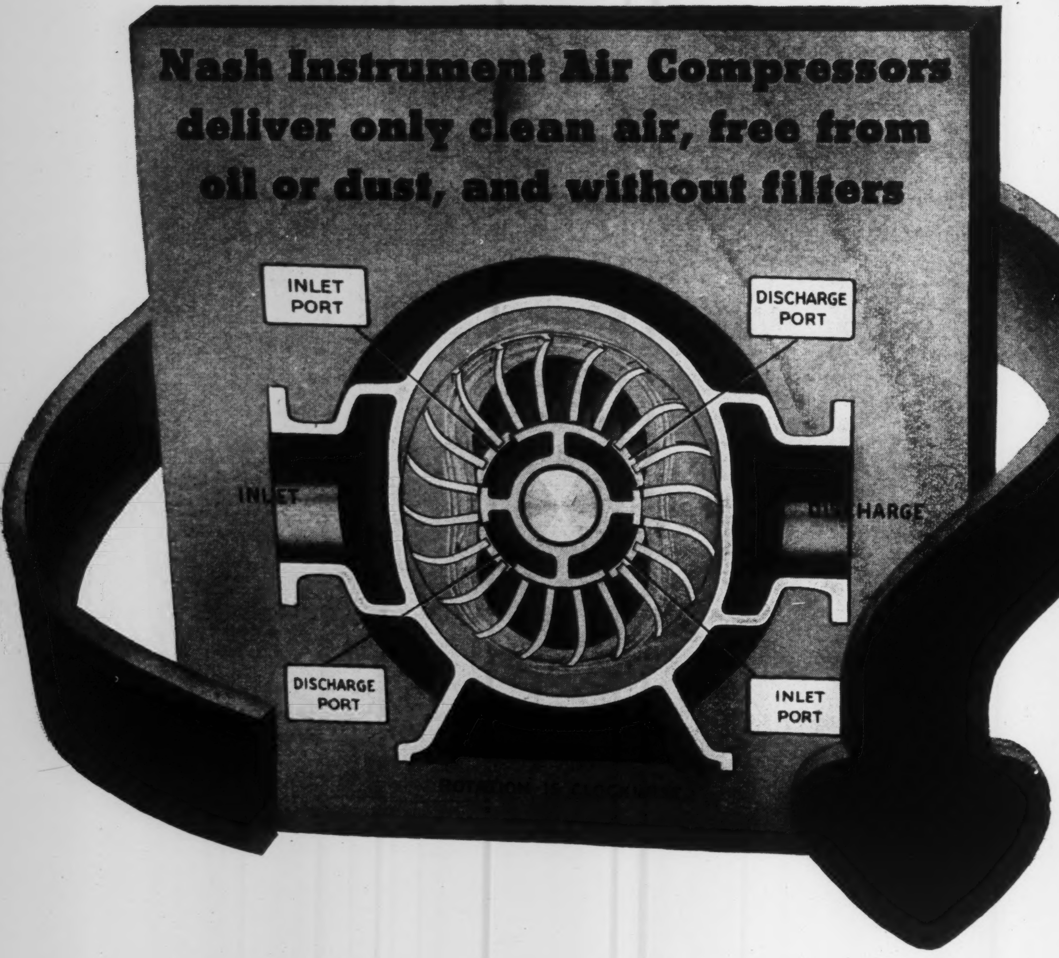
*Adaptability*
**with ½% resistors**

**Try This Volt-Ohm-Mil-Ammeter at your distributor's**

CAUTION ON HIGH VOLTS
OFF
6000
1200
300
6000
1200
300
60

**Triplett**
TRIPLETT

TRIPLETT ELECTRICAL INSTRUMENT CO., BLUFFTON—OHIO


Nash Instrument Air Compressors deliver only clean air, free from oil or dust, and without filters
INLET PORT
DISCHARGE PORT
INLET
DISCHARGE
DISCHARGE PORT
INLET PORT
ROTATION IS CLOCKWISE

# *Here is Why!*

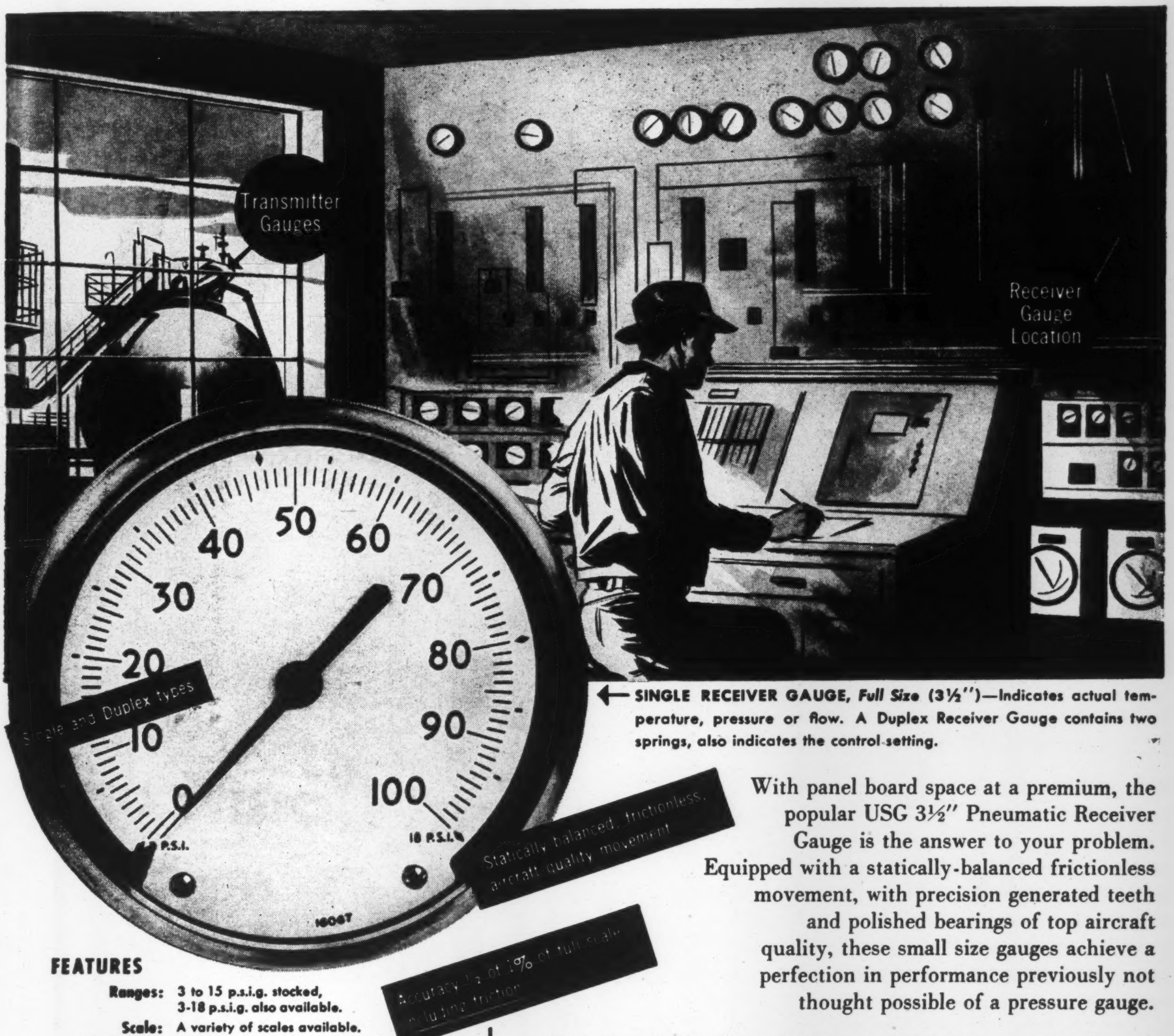
You can dispense with oil filters and dust filters when you install ®Nash® Clean Air Compressors. You can save the cost of maintaining these devices. You can greatly reduce instrument maintenance costs. For the Nash employs no internal lubrication, therefore no troublesome oil is in the delivered air. Moreover, air from a Nash is thoroughly washed and cooled as it passes thru the pump. Dust in the plant atmosphere, even fly ash, is immediately removed.

®Nash® Clean Air Compressors are simple, with only one moving element. No valves, gears, pistons, sliding vanes, or other enemies of long life and constant performance complicate a Nash. No aftercoolers are needed. You will find it profitable to investigate these pumps, now.

**No oil filters.**
**No dust filters.**
**No internal lubrication to contaminate air handled.**
**No internal wearing parts.**
**No valves, pistons, or vanes.**
**Non-pulsating pressure.**
**Original performance constant over a long pump life.**
**Low maintenance cost.**

**NASH ENGINEERING COMPANY**
**370 WILSON, SO. NORWALK, CONN.**

# Read pressure, temperature or flow at a distance with USG Pneumatic Receiver Gauges


Transmitter Gauges
Receiver Gauge Location
40
50
60
30
70
20
80
10
90
0
100
P.S.I.
18 P.S.I.
160GT
Single and Duplex types
Statically balanced, frictionless, aircraft quality movement
Accuracy ½ of 1% of full scale including friction

← **SINGLE RECEIVER GAUGE,** ***Full Size*** **(3½″)**—Indicates actual temperature, pressure or flow. A Duplex Receiver Gauge contains two springs, also indicates the control setting.

With panel board space at a premium, the popular USG 3½″ Pneumatic Receiver Gauge is the answer to your problem. Equipped with a statically-balanced frictionless movement, with precision generated teeth and polished bearings of top aircraft quality, these small size gauges achieve a perfection in performance previously not thought possible of a pressure gauge.

## FEATURES

**Ranges:** 3 to 15 p.s.i.g. stocked, 3-18 p.s.i.g. also available.
**Scale:** A variety of scales available.
**Case Diam.:** 3¾″
**Bezel Opening:** 3½″
**Pressure Elements:** Phosphor Bronze, AAA width, stress-relieved.
**Movement:** Aircraft quality — phosphor bronze and stainless steel.
**Adjustments:** ±1% maximum linearity adjustment with adjustable tip; micro-adjustable pointer permits rotation with respect to pinion for zero adjustment.
**Stops:** Zero and over-range.
**Case:** Drawn steel, black crinkled finish, bevelled glass.
**Socket:** Extruded brass.

**SINGLE OR DUPLEX TYPES**—The USG Receiver Gauge is graduated to the same scale as the transmitter gauge yet operates at a very small pilot pressure. It is available with a single spring or double spring (Duplex Receiver Gauge).

**GAUGES CARRIED IN STOCK**—USG Receiver Gauges are stocked without dials in the range of 3-15 lbs. This permits easy assembly and quick shipment of gauges with dials calibrated to your choosing. Single-spring gauges are available in ¼″ low male or center back connection. Duplex gauges are available in low back connection with ⅛″ or ¼″ male pipe thread and 5/16-28 tubing connection.

United States Gauge, Division of
American Machine and Metals, Inc.,
Sellersville, Pa.

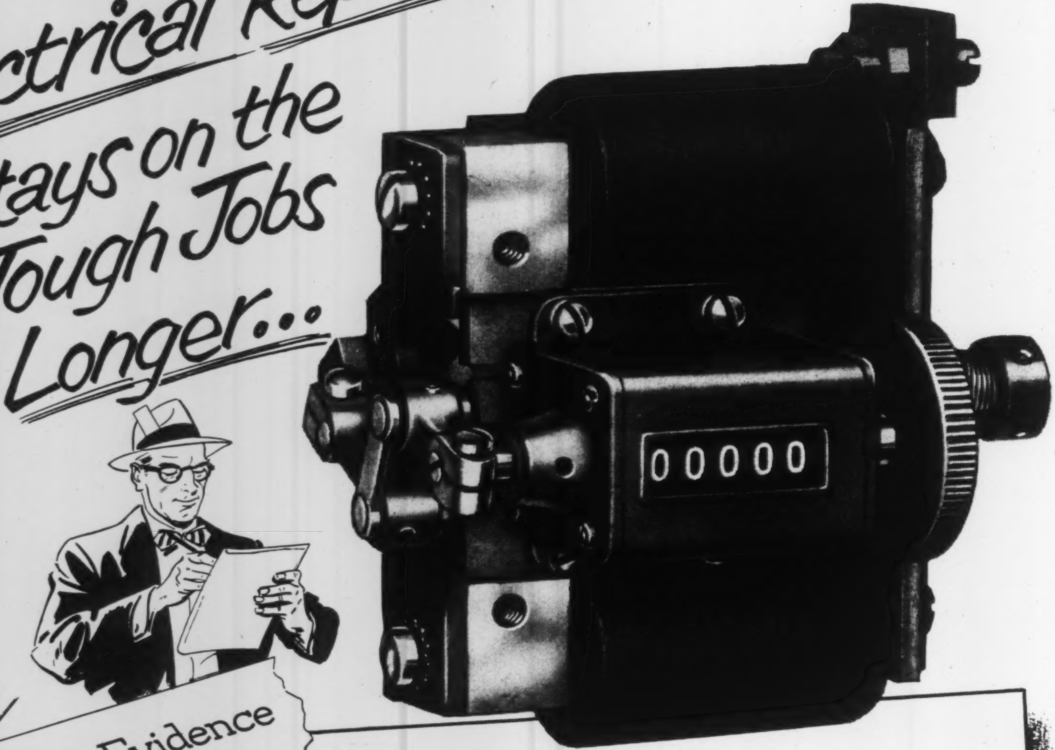
**USG**
UNITED STATES GAUGE

*Quality Gauges Engineered for Enduring Accuracy*

**PRODUCTS OF UNITED STATES GAUGE**... Absolute Pressure Gauges • Aircraft Instruments • Air Volume Controls • Altitude-Gauges • Boiler Gauges • Chemical Gauges • Mercury, Gas, and Vapor Dial Thermometers • Glass Tube and Industrial Thermometers • Flow Meters • Inspectors' Test Gauges • Precision Laboratory Test Gauges • Marine, Ship and Air-Brake Gauges • Voltmeters • Ammeters • Welding Gauges

**OTHER DIVISIONS OF AMERICAN MACHINE AND METALS, INC., AT SELLERSVILLE, PA.:**
**GOTHAM INSTRUMENTS AND AUTOBAR SYSTEMS**

# This Electrical Reporter Stays on the Tough Jobs Longer...



Added Evidence that

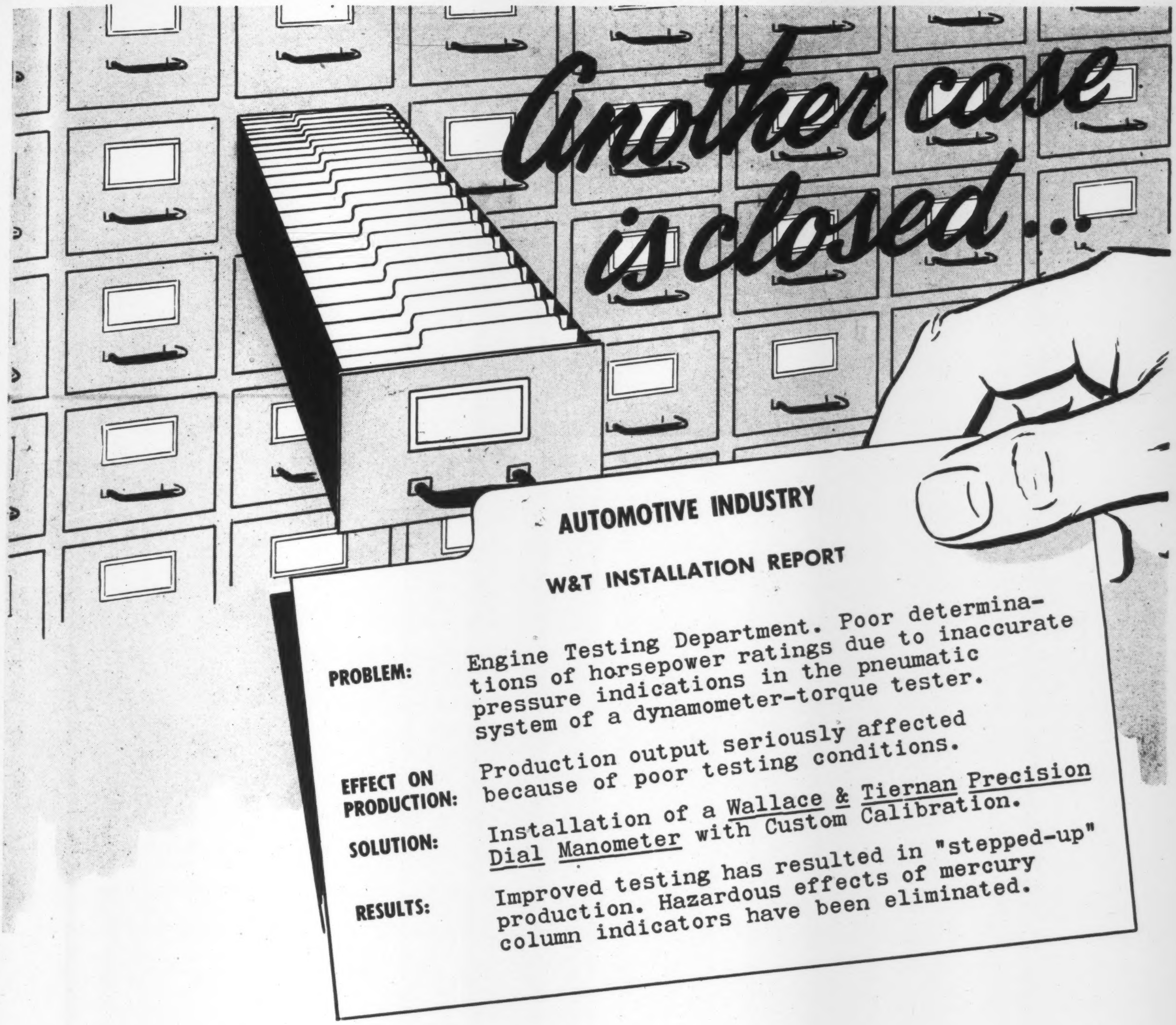
## Everyone Can Count on

# VEEDER-ROOT

Compact and rugged . . . this electrically operated reset counter is specially designed for tough jobs that demand longer counter life.

Here's another instance of the *infinite applicability* of Veeder-Root *Count*rol — electrical, mechanical or manual. And here's another instance, too, of the endless resourcefulness of Veeder-Root engineering, and the ability to design a *complete counting package* that fits the job fully and exactly. Now . . . what's *your* problem?

**VEEDER-ROOT INCORPORATED**
"The Name That Counts"
**HARTFORD 2, CONNECTICUT**
Chicago 6, Ill. • New York 19, N.Y. • Greenville, S.C
Montreal 2, Canada • Dundee, Scotland
Offices and Agents in Principal Cities


Another case is closed...

**AUTOMOTIVE INDUSTRY**

**W&T INSTALLATION REPORT**

**PROBLEM:** Engine Testing Department. Poor determinations of horsepower ratings due to inaccurate pressure indications in the pneumatic system of a dynamometer-torque tester.

**EFFECT ON PRODUCTION:** Production output seriously affected because of poor testing conditions.

**SOLUTION:** Installation of a Wallace & Tiernan Precision Dial Manometer with Custom Calibration.

**RESULTS:** Improved testing has resulted in "stepped-up" production. Hazardous effects of mercury column indicators have been eliminated.

## ...Thanks to a W&T Precision Instrument

**FEATURES:**

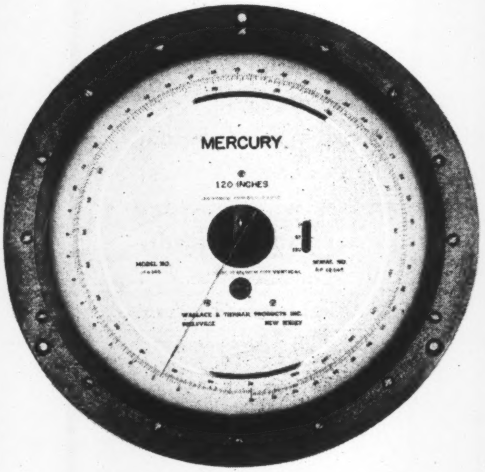
**Full protection against overpressure**

**Custom calibrated scales in units of force or torque**

**Two revolution indicator provides scale 45 in. long with only an 8½ in. diameter dial.**

**Sensitivity one part in 10,000; accuracy one part in 1000.**

**If you have a problem in the measurement or control of pressure, write today for additional information.**



W&T Precision Dial Manometer

**WALLACE & TIERNAN**
**PRODUCTS, INC.**
ELECTRICAL MECHANISMS AND PRECISION INSTRUMENTS
**Belleville 9, New Jersey • Represented in Principal Cities**
**In Canada, Wallace & Tiernan Products, Ltd. — Toronto**

A-93

# The most *Comprehensive* line of dependable PANEL INSTRUMENTS

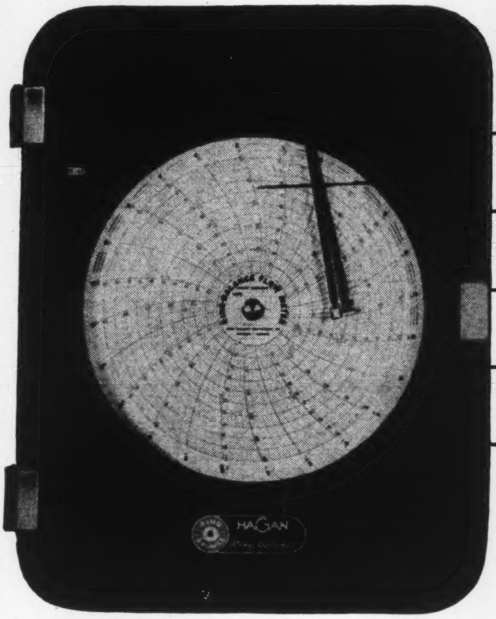
0 10 20 30 40 50 60 70
AMPERES D.C.
WESTON
WESTON
30 60 90 120 150
VOLTS D.C.
30 60 90 120 150
VOLTS A.C.
WESTON
VOLTS A.C.
MILLIAMPERES
1
2
3
4
5

There are no blanks in the WESTON line of panel instruments. It includes all the sizes . . . all the types, ranges, sensitivities, too. Many specials, as well; developed to meet unusual requirements. All are built in the finest WESTON tradition for sustained accuracy over years of dependable service. Your local WESTON representative will gladly cooperate on any panel instrument problem, or write direct to . . . WESTON Electrical Instrument Corporation, 617 Frelinghuysen Avenue, Newark 5, New Jersey . . . *manufacturers of Weston and Tag instruments.*

**WESTON** PANEL *Instruments*

797

# *Specify* HAGAN
# RING BALANCE FLOW METERS



## *and you get*

- **Ease of dead weight calibration**
- **No stuffing boxes**
- **Mercury level not critical**
- **High sensitivity at low flow rates**
- **Adjustable full scale range**

### This is the versatile Hagan Ring Balance Flow Meter

Models are available which will record, indicate and integrate two flows on a single chart. Standard modifications provide pressure and temperature compensation. Ring assemblies available can measure differentials from 1″ to 420″ water column maximum at static pressures up to 3,000 psig.

**HAGAN RING BALANCE METERS** provide dependable, accurate flow measurement of oxygen, water, steam, gas, oil or other fluids. Design is simple, maintenance costs low.

• • •

For more information about Hagan Ring Balance Flow Meters, and how they can help you solve your metering problems, fill out the coupon.

*Clip this coupon for information*

**HAGAN CORPORATION**
HAGAN BUILDING, PITTSBURGH 30, PA.
BOILER COMBUSTION CONTROL SYSTEMS
RING BALANCE FLOW AND PRESSURE INSTRUMENTS
METALLURGICAL FURNACE CONTROL SYSTEMS
CONTROL SYSTEMS FOR AUTOMOTIVE AND
AERONAUTICAL TESTING LABORATORIES

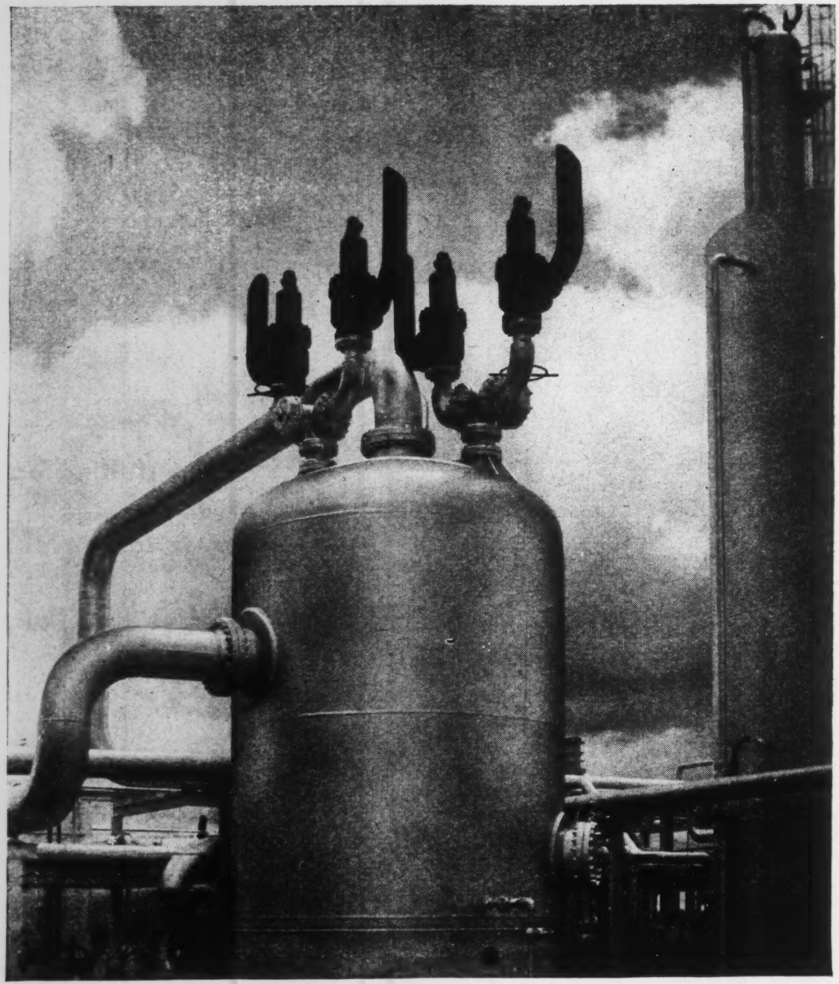
HAGAN
HALL
BUROMIN
CALGON

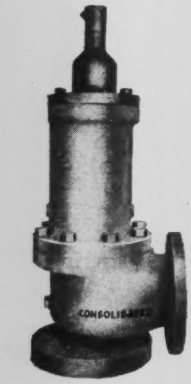
**Hagan Corporation**
**Hagan Building**
**Pittsburgh 30, Pennsylvania**

**Please send me further information on Hagan Ring Balance Meters. I am particularly interested in..........................**
**..........................................................................**
**NAME..........................................................................**
**POSITION..........................................................................**
**COMPANY..........................................................................**
**STREET AND NUMBER.... ..........................................................**
**CITY.......................................ZONE..........STATE......**

I-12;

Consolidated Safety Relief Valves installed on main scrubber at Stanolind Oil & Gas Co., Stano, Kansas.





# NO WORRY ABOUT OVERPRESSURES HERE!

**DEPENDABLE TIGHTNESS** is paramount in valve safety standards. That's why Consolidated Safety Relief Valves are so widely used throughout the process industries. They provide absolute protection against overpressures in piping, pumps, processing equipment and storage tanks—safeguard life, property and production, even in the severest service.

Key to the reliable safety of Consolidated Safety Relief Valves lies in their superior design and construction. Outside bevel seat and floating guide construction permit the disc to seat on a radial seating surface. Leakage due to *discharge piping stresses* is impossible. Complete tightness is assured in all positions within the deflection range. Maintenance and standardization problems are minimized: Consolidated Safety Relief Valves have 25% fewer parts than ordinary safety valves. Service life is outstanding.

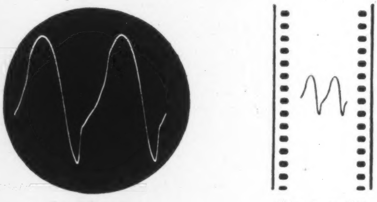
For absolute protection against overpressures . . . for continuous, economical performance at the rated capacity—invest in Consolidated Safety Relief Valves. Your local distributor will gladly give you all the facts about their quality and operational features.

## CONSOLIDATED SAFETY RELIEF VALVES

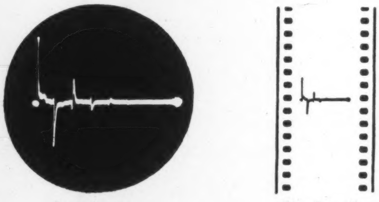
A product of MANNING, MAXWELL & MOORE, INC. TULSA, OKLAHOMA

MAKERS OF 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'HANCOCK' VALVES, 'ASHCROFT' GAUGES. BUILDERS OF "SHAW-BOX" CRANES. 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

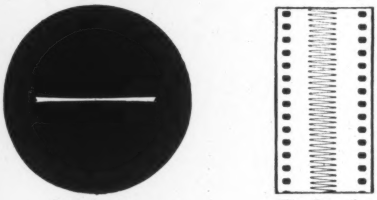
# How much can you expect an oscilloscope camera to do?


Scope Image — Film Recording

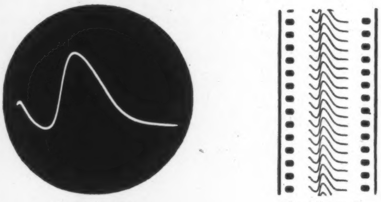
1. Single-frame photography of stationary patterns using a continuously running sweep.


Scope Image — Film Recording

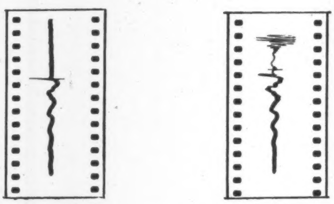
2. Single-frame photography of single transients using a single sweep.


Scope Image — Film Recording

3. Continuous-motion photography employing film motion as a time base.


Scope Image — Film Recording

4. Continuous-motion photography employing oscilloscope sweep as a time base.


FILM MOTION TIME BASE — FILM MOTION & SCOPE SWEEP

5. Continuous-motion photography employing combination of film motion and oscilloscope sweep as a time base.

It's only reasonable that you should expect the oscilloscope camera you buy to record what you see on an oscilloscope screen during any period. But can it be expected to do any more? We think so.

For example, did you know that the *Fairchild Oscillo-Record Camera*—our idea of the most versatile 35-millimeter oscilloscope camera now available—can GREATLY EXTEND THE USEFULNESS OF YOUR OSCILLOSCOPE?

As you know, many non-recurring phenomena occur too rapidly to permit adequate visual study. Others occur so slowly that continuity is lost. Sometimes you have combinations of very slow-speed phenomena and occasional high-speed transients. In any one of these cases, the Fairchild Oscillo-Record Camera will take over where your eye and the oscilloscope leave off.

This extremely versatile instrument is now being used daily by many hundreds of engineers in widely divergent fields. For an idea of what it can do for you, study the five scope images and recordings illustrated at left. Each solves a particular problem.

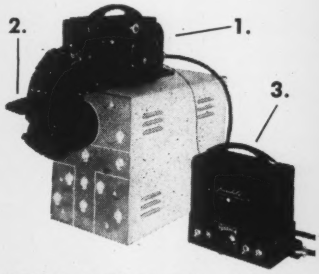
Oscillo-Record users especially like its:

**CONTINUOUSLY VARIABLE SPEED CONTROL**—1 in./min. to 3600 in./min.

**TOP OF SCOPE MOUNTING** that leaves controls easily accessible.

**PROVISION FOR 3 LENGTHS OF FILM**—100, 400, or 1000 feet.

For more data write *Fairchild Camera Instrument Corp., 88-06 Van Wyck Blvd., Jamaica 1, N. Y. Dept. 120-16F2.*

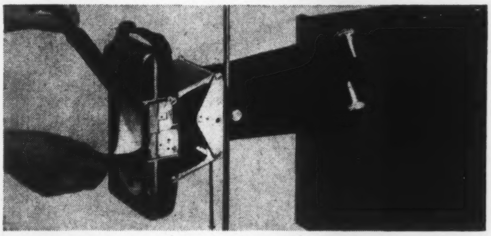


**FAIRCHILD OSCILLO-RECORD CAMERA** — 1. camera, 2. periscope, 3. electronic control unit. *Available accessories* include external 400 and 1000 foot magazines, magazine adaptor and motor, universal mount for camera and periscope, binocular split-beam viewer.

## VALUABLE RECORDS FOR IMMEDIATE EVALUATION

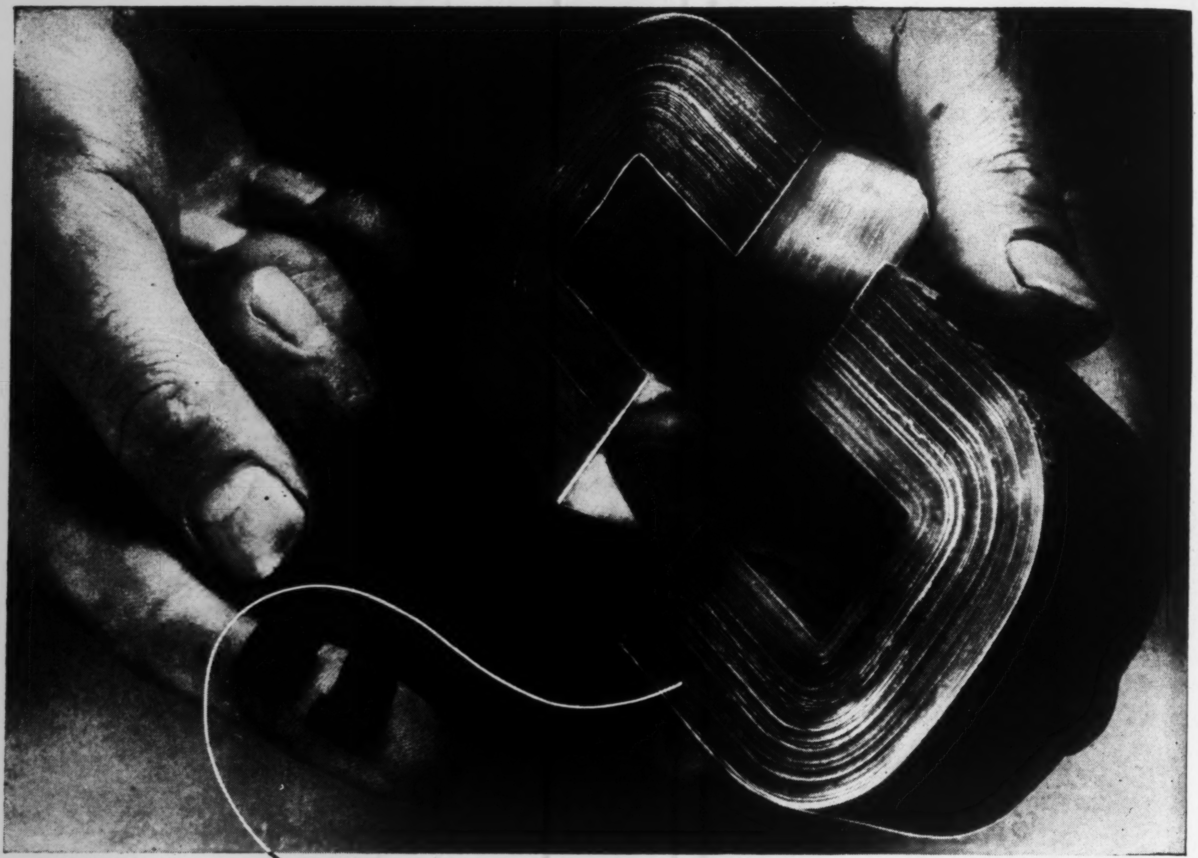
**The Fairchild-Polaroid® Oscilloscope Camera produces a photographic print in a minute**

Valuable but inexpensive oscillograms for immediate evaluation; automatic one-minute processing without a darkroom; a set up time of two minutes or less—they're just three of the many advantages that are yours when you use the Fairchild-Polaroid Oscilloscope Camera. Wherever individual exposures meet your recording requirements—where you'd like to have permanent records of the traces you're now sketching or carrying in your memory, this is the camera that can bring new speed, ease and economy to your job. Prints are 4¼x3¼ and each records two traces exactly one-half life size. Write today for details.



**A minute after you've pulled the tab a finished print is ready for evaluation**

**FAIRCHILD**
**OSCILLOSCOPE RECORDING CAMERAS**



# SILECTRON C-CORES...BIG or LITTLE

## ...*any quantity and any size*

Wound from precision rolled oriented silicon steel strip as thin as .00025"

For users operating on government schedules, Arnold is now producing C-Cores wound from ¼, ½, 1, 2, 4 and 12-mil Silectron strip. The ultra-thin oriented silicon steel strip is rolled to exacting tolerances in our own plant on precision cold-reducing equipment of the most modern type. Winding of cores, processing of butt joints, etc. are carefully controlled, assuring the lowest possible core losses, and freedom from short-circuiting of the laminations.

We can offer prompt delivery in production quantities—*and size is no object, from a fraction of an ounce to C-Cores of 200 pounds or more.* Rigid standard tests—and special electrical tests where required—give you assurance of the highest quality in all gauges. ● *Your inquiries are invited.*

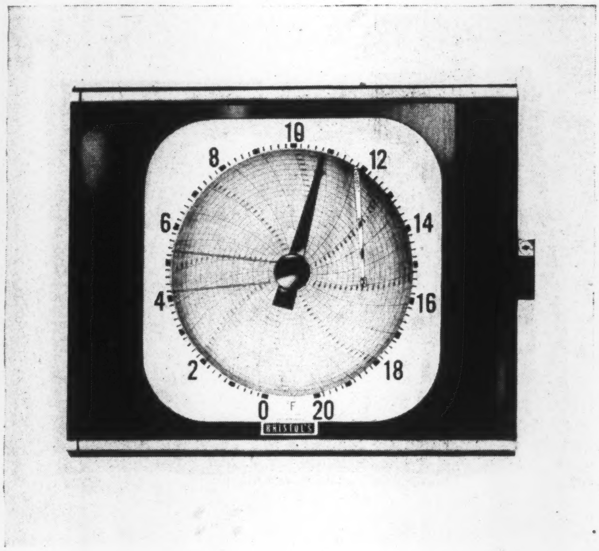
**THE ARNOLD ENGINEERING COMPANY**

SUBSIDIARY OF ALLEGHENY LUDLUM STEEL CORPORATION

General Office & Plant: Marengo, Illinois

W&D 4363

# BRISTOL ELECTRONIC DYNAMASTER POTENTIOMETERS feature Continuous Standardization!



**advantage 1:**

### No dry cells to fuss with . . .

**thanks to Bristol's constant voltage source, which is continuously compared with the voltage of a standard cell.**

**advantage 2:**

### Continuous operation . . .

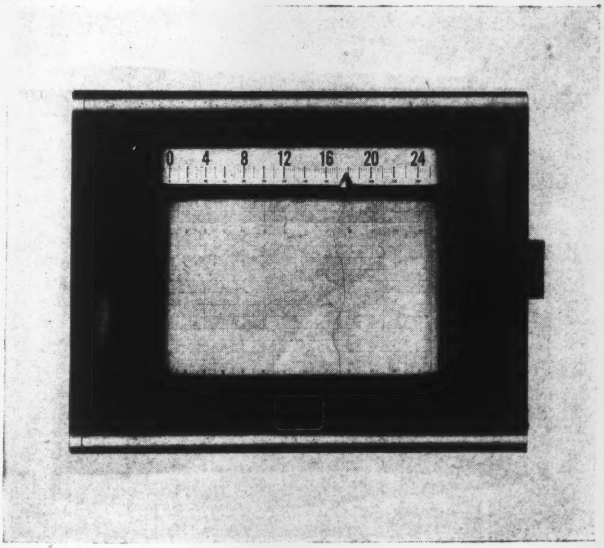
**no interruptions for standardization.**

**advantage 3:**

### No standardizing mechanism

***No wonder the Dynamaster is the finest-performing potentiometer on the market!***

**BRISTOL DYNAMASTER** with round (above) and strip (right) charts feature identical components and units, except for the chart drive.



## Bristol Electronic Dynamaster Potentiometers for every use!

*Recorders*—single and multiple records and two continuous ink records;

*Electric Controllers* — on-off and all types of proportioning control;

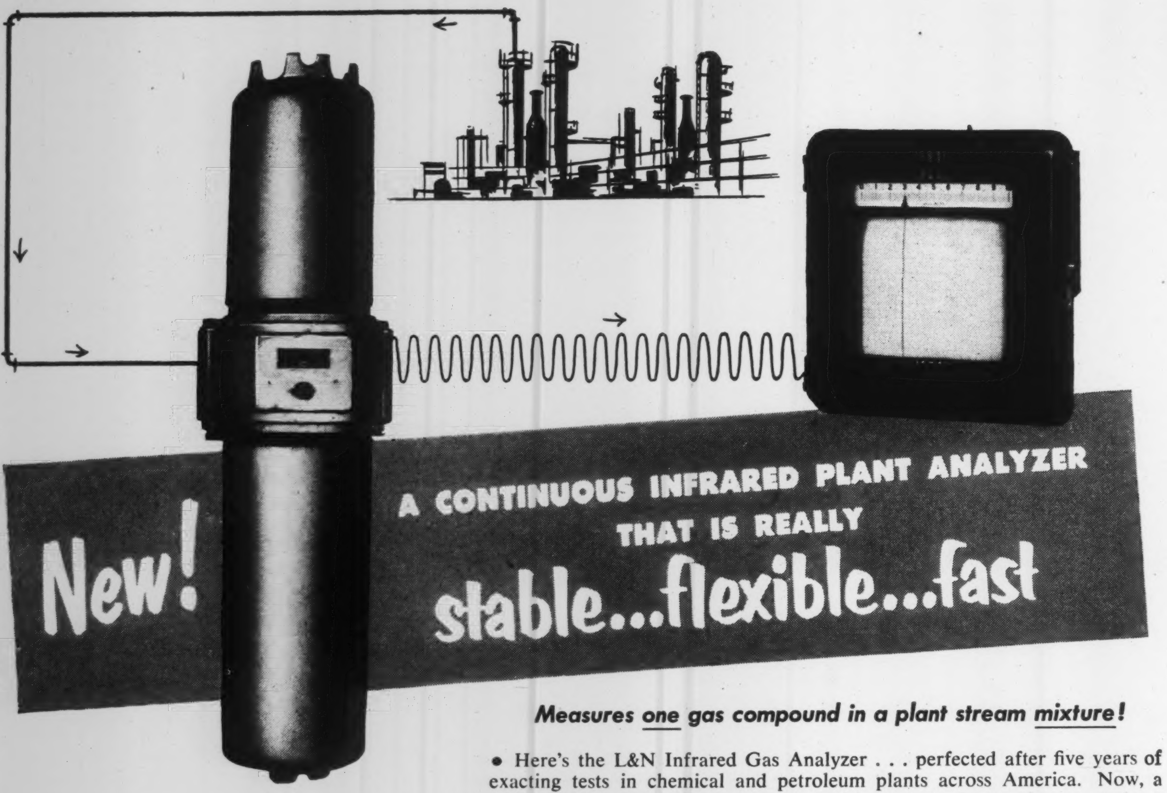
*Air-Operated Controllers*—on-off, proportional (0 to 30% and 0 to 100%), reset, derivative, and reset plus derivative control actions.

**Write for free Catalog P1245** to The Bristol Company,
113 Bristol Road, Waterbury 20, Conn.

# BRISTOL

*The dependable Guidepost of Industry*

**AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS**



# New! A CONTINUOUS INFRARED PLANT ANALYZER THAT IS REALLY stable...flexible...fast

### *Measures one gas compound in a plant stream mixture!*

• Here's the L&N Infrared Gas Analyzer . . . perfected after five years of exacting tests in chemical and petroleum plants across America. Now, a selected gas compound can be measured by means of a continuous analyzer that is really stable, flexible and fast. Here's permanent 7-day stability. Here's the flexibility of a range-changing dial. Here's a measuring speed of only a few seconds.

This new L&N Infrared Gas Analyzer also provides high measuring discrimination. It is so designed that it measures radiation absorbed only by the selected gas compound. Here's how! Compounds in the continuously-flowing gas stream absorb portions of radiation passing through a sample cell. The radiation absorbed by the background gases either cancels out automatically or is blanketed by a filter cell, eliminating the effect of any interfering compounds. The L&N Analyzer then compares the remaining radiation against a radiation "reference." The difference represents only the absorption of the selected gas compound. A differential thermopile . . . possibly the most accurate type of radiation detector . . . produces a proportional emf. An extremely sensitive Speedomax records the % concentration of the compound.

Here's why measurements are so stable! Voltage at the infrared source is regulated within 0.1% to assure a constant amount of transmitted radiation. Only one beam of radiation passes through the sample cell to minimize dispersion. Cells containing sensitizing gases are permanently sealed against leakage. Furthermore, the d-c thermopile provides inherently high stability.

Then, consider the flexibility of the L&N Analyzer! A turn of a dial is all that's needed to change ranges. One design of analyzer cell column handles all measurements. This design permits various lengths of cells to be used for maximum sensitivity. It's only necessary to slide a bracket and insert the desired sample or filter cell. The L&N equipment also offers flexibility of choice. It can be supplied calibrated or uncalibrated . . . for single or multiple-point recording . . . for electric or pneumatic control . . . with explosion-resistant or standard housings . . . with automatic or manual gas standardization.

Real measuring speed is still another feature! The thermopile responds immediately to all concentration changes. As a result, the L&N Analyzer first shows a change in only 3 seconds . . . records 90% of the change in 10 seconds.

The L&N Infrared Gas Analyzer is ready to go to work at your plant now. Send the coupon today for the kind of information you want.

### *Check These Ranges and Performance Facts!*

#### PERFORMANCE DATA

In a typical application, the L&N Infrared Gas Analyzer is used to measure $CO_2$ in nitrogen. Here are the results obtained over the extremely narrow range of 0 to 0.08% $CO_2$.

*Stability* . . . . . ±0.002% $CO_2$
*Sensitivity* . . . . ±0.0004% $CO_2$
*Readability* . . . Within 0.001% $CO_2$

#### RANGES

The L&N Infrared Gas Analyzer can be calibrated for many different gas compounds and ranges. For purposes of illustration, however, the table below lists only the ranges available for the measurement of $SO_2$, $CH_4$, $CO_2$, or CO in nitrogen.

| GAS | RANGES | | |
|---|---|---|---|
| | Beginning at Zero | | Where Range Starts Above Zero |
| | Minimum | Maximum | |
| $SO_2$ | 0 to 0.08% | 0 to 10% | Span of at least 10% |
| $CH_4$ | 0 to 0.15% | 0 to 10% | between 10% and 50% |
| $CO_2$ | 0 to 0.08% | 0 to 5% | Span of at least 15% |
| CO | 0 to 0.2% | 0 to 8% | between 5% and 50% |

**LEEDS & NORTHRUP**
**4955 Stenton Ave., Phila. 44, Pa.**

☐ Please send your data and specification sheets for the new L&N Infrared Gas Analyzer.

☐ I understand you have a pictorial demonstrator which shows clearly how the L&N Analyzer works and how it can be used for many different measurements. I would like to see this presentation.

Name__________
Title__________
Dept.__________
Company__________
Address__________

Jrl. Ad ND46-91(2)

**LEEDS & NORTHRUP**
instruments · automatic controls · furnaces

# Editorial Comment

## The Strong Link

ONLY six percent of the world's people live within the United States. Yet these six percent are the healthiest and wealthiest in the world and produce almost half the world's industrial goods. This obviously has not been achieved by numbers, but by wealth of resources and by effective technical and industrial organization. Other nations in the world now are raising their industrial levels and competing with us for power. If the United States is to maintain its position of world power and leadership, it must continuously increase its productivity in manufacturing and its efficiency in research.

This fact is not recognized everywhere. For example, our education of technical manpower is far below the safety level. In the future, therefore, increased usage of instrumentation to further increase both the per capita output and the technological level of America will be doubly essential.

Management executives and all leaders of industry, finance, and research should keep in mind that the superiority of the American research and industrial machine is due largely to vast use of instruments. As shortages of technically trained manpower become more serious, and as the demands on the American people become more pressing, accelerated use of instrumentation will become vital.

## Instruments in Research

RESEARCH MANAGEMENT in the past has had the feeling that each research man is a skilled instrument man; indeed, they often expected the research man to design his own instruments. Although many research men did wonders, even to the extent of designing their own instruments, the result was duplication and inefficiency.

Management today is becoming aware of the importance of using commercial instruments to best advantage. There is a definite trend in research laboratories today toward organization of instrument sections within the laboratory. Laboratory management is learning rapidly that the use of a laboratory worker for stirring solutions and writing down readings is inefficient indeed. Instruments are available for performing a large percentage of the tasks now done manually in many (but not all) research laboratories. For example, the research laboratories of the following organizations have organized instrument sections: Mellon Institute of Industrial Research, Pittsburgh Plate Glass Co., Battelle Memorial Institute, Southwestern Research Institute, Johns-Manville Co., and many others.

## Instrument Electronics

THE FINAL chapter of the home-study serial "Instrument Electronics" by M. H. Aronson is being cleared by the Department of Defense and will be published in the January issue. The publication of a home-study-type series of articles was experimental; but the response was gratifying. Several hundred readers wrote in to tell us that the articles were of great value to them personally. In addition, many companies informed us that they are using the serial for training purposes. Owing to its reception, we are rushing the publication of the serial in book form. The book will be available early in 1953.

## 1952 Subject Index

THE index of subjects and authors for the 1952 issues of *Instruments* will appear in the January 1953 issue.

## Inventory

IN 1952, its 25th year of service, *Instruments* brought you reviews of 1141 new instruments and 1297 new bulletins and catalogs. Every technical worker in every scientific and industrial field should know about and use this important service. Nowhere else is this vital knowledge available in such concise and easy-to-use form.

New products, together with the new literature that the manufacturers produce, is an important source of authoritative up-to-date information in any field. The instrument industry deserves special commendation for its literature. An illustrated brochure or catalog is not inexpensive; nor is the instrument industry the richest in the country. Yet no segment of American industry produces better or more complete manufacturers' literature than the instrument manufacturers. Nor does any industry devote greater effort to assist workers in the field with technical data and literature. This service makes it possible for anyone to obtain beautifully written and illustrated technical data on any part of the vast field of instrumentation.

We wish to remind all readers to keep their *Instruments* on file. The new-instrument and new-literature reports alone are a service beyond the financial capacities of the largest consultant service. Every reader of *Instruments* should and can be an expert in his field—by knowing the latest new instruments and laboratory apparatus, by receiving the literature in his field of endeavor, and by becoming completely familiar with the wealth of information that he receives with each issue.

We want each reader to know also that his *Instruments Index*, which he will receive in July 1953, will contain over 1600 manufacturers and over 20,000 basic instruments.

For 1953, our plans include the expansion of every phase of your magazine. You will receive more new-instrument reviews, more new-literature releases, and more technical articles. The January issue also begins a new serial "Automatic Control of Chemical Processes" by A. J. Young, Chief of Instrumentation, Imperial Chemical Industries, Ltd., London, England.

## A New Service

ON page 1766 of this issue you will find a classified index of instruments described in advertisements. For more information on any of the subjects listed, just write the identifying number on the postage-free card on page 1775. This new service will enable all readers of *Instruments* to locate advertised instruments quickly.

ISSUES

**The Counter Reads** 0|0|3|0|0

**and thereby registers the end of the twenty-fifth year of *Instruments'* service to users of measurement and control devices—service to THE UNITED STATES OF AMERICA**

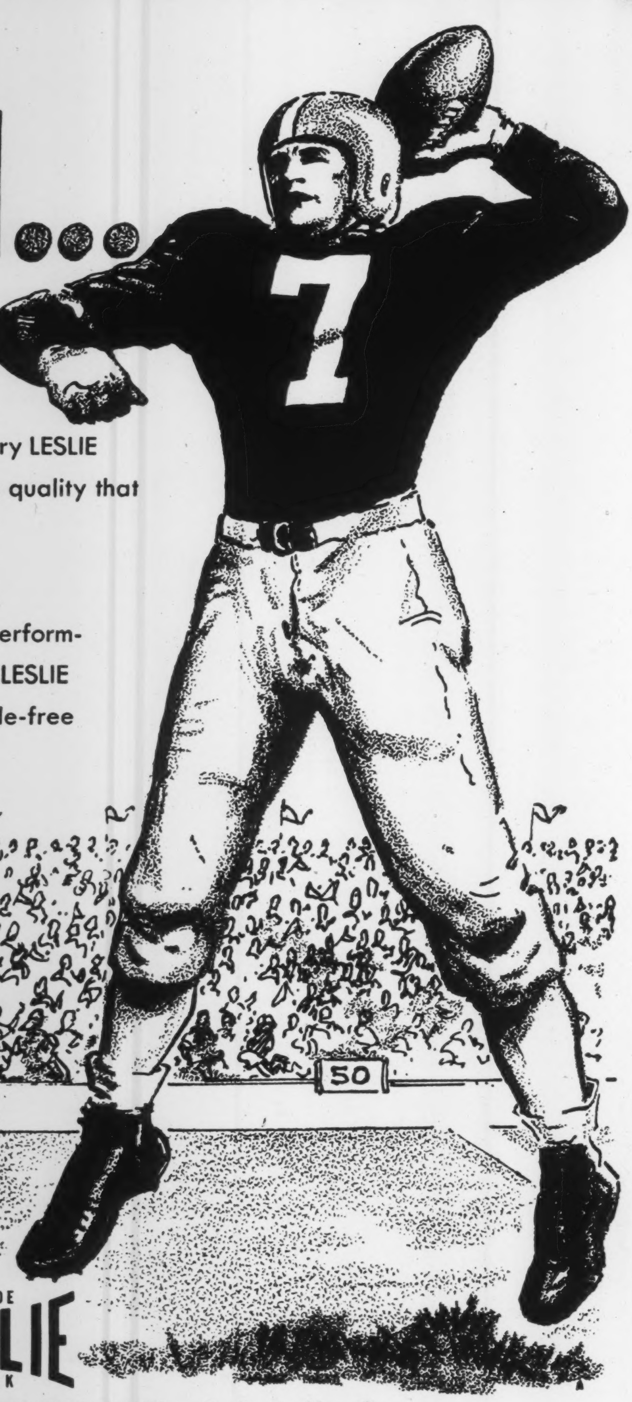
**The entire staff of *Instruments* wishes you**

**A Merry Christmas and**
**A Happy New Year**

# Dependable Control...

***The same unerring control***
that directs a pass into the waiting arms of a speeding end is a "built-in" advantage of every LESLIE Regulator. In automatic controls, as in sports, it's quality that makes the difference.

The fundamental principles of quality design, quality materials, quality manufacture, quality performance and quality service all combine to make LESLIE a logical choice for long-lasting, accurate, trouble-free pressure, temperature, or liquid level control.



CLASS L-3
107088
300LBS M.S.
3 LESLIE LYNDHURST, N.J.

**Class L-3**
**Pressure Reducing Valve**

TRADE
**LESLIE**
MARK

**PRESSURE REDUCING VALVES** —For Steam, Air or Gas.
**PUMP GOVERNORS** —For pump discharge pressures.
**DIAPHRAGM CONTROL VALVES** —For use with instrument controllers.
**TEMPERATURE REGULATORS** —For process heating or cooling.
**CONTROL PILOTS** —For pressure, temperature, and level control.

**SELF-CLEANING STRAINERS • AIR HORNS • STEAM WHISTLES**

*Write for illustrated bulletin on type of regulator desired.*

1798

**LESLIE CO.** 299 Grant Avenue, Lyndhurst, New Jersey

QUALITY REGULATORS FOR OVER HALF A CENTURY

# The Month's NEW INSTRUMENTS

**In this department we report each month new devices for measurement, inspection, testing, computing, metering and automatic control—in the form of concise technical descriptions.**

FOR FURTHER INFORMATION USE THE POSTAGE-FREE ORDER CARD ON PAGE 1775

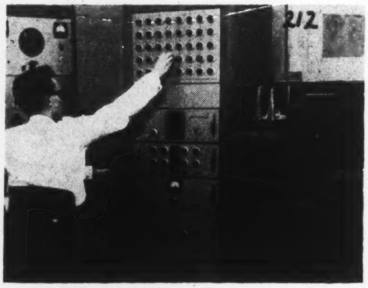
## Counter-chronometer Tachometer

New "Model 556 Events-Per-Unit-Time Meter (EPUT)" is a high-speed electronic counter combined with a time base which is used to control counting interval. Counting rate, 20 to 100,000 events per second; counting interval, 1 second. Instrument counts and displays in decimal form the number of events that occur during 1-second interval; can be used by unskilled personnel. Accuracy: plus-or-minus 1 event with suitable time base. Using normal power line, accuracy is 0.2 percent. Sensitivity: 0.2 volt r.m.s. over range of 20 to 100,000 kc.; pulses of positive polarity are required. Display time continuously variable from 1 to 5 seconds. Time base: 0.1 and 1 second for standard model.—*Berkeley Scientific Div., Beckman Instruments, Inc.,* 2200 *Wright Ave., Richmond, Calif.*

**Mention No. 1601 when filling out card.**

## Analog-digital Converter for Mass Spectrometer

New "Spectro-SADIC" is for use in conjunction with analytical mass spectrometer in routine analytical work where large numbers of similar mixtures must be assayed daily in standard control work. Direct automatic conversion of mass-spectrometer data into digital form of 0.1 percent accuracy eliminates picking of individual peaks on records. Digital values of peak heights are available immediately after scan in either punchboard form for direct insertion into IBM calculators or in tabulated form for substitution in matrices and subsequent reduction by other computing methods. Time to scan a mass number and record its peak height is 10 seconds. Up to 40 mass numbers may be pre-selected and programmed in range of either mass 40 through 150 or from 12 through 122. Once adjusted, system is completely automatic.—*Consolidated Engineering Corp.,* 300 *N. Sierra Madre Villa, Pasadena* 8, *Calif.*



**Mention No. 1602 when filling out card.**

## Self-balancing Indicator-controller

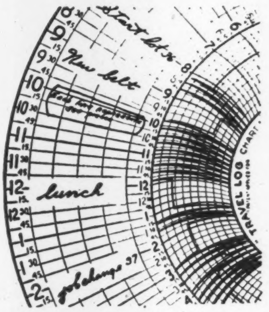
New "Type RI-C Indicator-Controller," primarily designed for solution-concentration control, has provision for up to four switches for alarm and control. Also available with 3-15-psi. air output; or combination of both electrical and air control. Features include plug-in chassis; range selection plus either manual or automatic temperature compensation by means of separate plug-in sub-chassis; built-in calibrating resistor; case purged of corrosive fumes through internal air pressure.—*Industrial Instruments, Inc.,* 89 *Commerce Road, Cedar Grove, N. J.*

15
20
10
30
8
40
6
50
4
2
0
100
SPECIFIC CONDUCTANCE
MICROMHOS/CM

**Mention No. 1603 when filling out card.**

## Production Recorder

New recorder for industrial machines indicates both potential and actual production, machine speed, and number and duration of stops. Dry stylus, driven by flexible cable from machine, oscillates over a clock-driven chart and records each piece produced. When machine stops or when production ceases, stylus stops oscillating. Write-in feature permits operator to explain cause of interruption.—*Knopf Instrument Co.,* 250 *Culver Ave., Jersey City* 5, *N. J.*



**Mention No. 1604 when filling out card.**

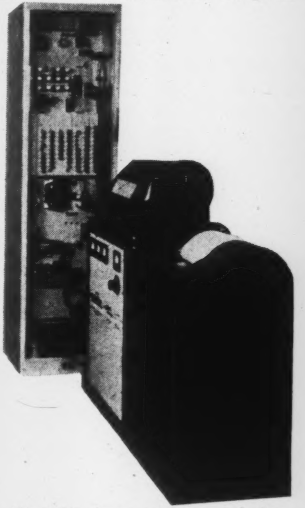
## Sixty-scan-per-second Spectrophotometer

New "Rapid Scanning Spectrophotometer" instantaneously displays spectrophotographic curves of various materials through entire visible spectrum. It combines an optical spectrophotometer and electronic indicating device which traces curves at 60 per second on cathode-ray tube face against a linear wavelength-percentage grid. Transparent materials up to 100mm. thick can be accommodated in sample chamber. Spectrophotometric reflectance curves may be obtained from opaque materials (approx. 1 sq. in.) by means of a reflection attachment. Because of its extreme speed, new instrument is adaptable to study of rapid color changes, or for handling a large volume of work. It offers possibilities for monitoring a flowing liquid in which spectral absorption can be used as a criterion for control. A long-persistence phosphor on CRT permits rapid visual comparison of two or more samples.—*American Optical Co., Southbridge, Mass.*

**Mention No. 1605 when filling out card.**

## Rapid Scanning System

New "Telescan" rapid scanning system comprises "Metrotype" system of numerical recording and telemetering which makes printed records of process data directly from primary information. Readings are presented in numerical form, tabulated for convenient use and on a single page for easy handling and storage. System records voltage, current, power, temperature, flow, or any other variable that can be translated to an electrical indication. "Telescan" also sets up an alarm for any abnormal condition. Messages are stored in form of "Tele-



Aerophysicists, Designers, Engineers

YOUR IDEAS WILL COUNT AT NORTH AMERICAN

North American encourages advanced thinking, because they know looking ahead is the only way to maintain leadership in the aviation industry. That's why North American needs men of vision. If you like hard thinking and would like to work for a company that will make the most of your ideas, you'll find real career opportunities at North American. North American offers you many extra benefits, too.

***North American Extras—***

Salaries commensurate with ability and experience • Paid vacations • A growing organization • Complete employee service program • Cost of living bonuses • Six paid holidays a year • Finest facilities and equipment • Excellent opportunities for advancement • Group insurance including family plan • Paid sick leave • Transportation and moving allowances • Educational refund program • Low-cost group health (including family) and accident and life insurance • A company 24 years young.

***Write Today***

Please write us for complete information on career opportunities at North American. Include a summary of your education, background and experience.

*IS YOUR FIELD LISTED HERE?*

Airborne Electronic Equipment
Equipment Flight Tests
Precision Instruments
Automatic Controls
Propulsion Systems
Servo-Mechanisms
Airframe Studies
Radar Devices
Instrumentation
Micro Wave Techniques
Metallurgical
Electroplating
Engineering Planning

**NORTH AMERICAN AVIATION, INC.**

*Aerophysics, Electro-Mechanical Research Division*

Dept. 4, Personnel Section,
12214 Lakewood Blvd., Downey, California

*North American Has Built More Airplanes Than Any Other Company In The World*

type" tape and read by tape transmitter. All numerical readings are made from actual primary data; are printed at rate of one per second, but tape is punched at rate of 25 digits per second. Tape can be used to operate directly into automatic business machines. Readings can be printed locally or transmitted any distance. Readings from many sources can be combined on same page.—*Tigerman Engineering Co.*, 4332 *North Western Ave., Chicago* 18, *Ill.*

**Mention No. 1606 when filling out card.**

## Digital Recorder

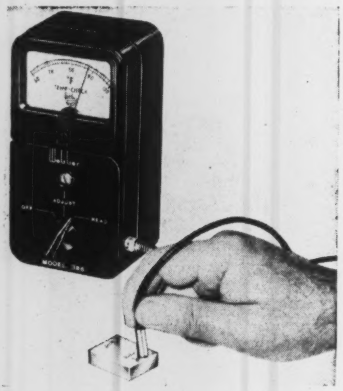
New "Series 1550 Digital Recorder" is a printed readout for high-speed electronic counter which provides a direct means of permanently recording sequential count information in Arabic numeral form on a standard adding machine tape. It is designed to operate from scalers other electronic totalizing devices at a maximum cycling rate of one printout every 0.8 second. It comprises two units: (1) Readout Unit consists of a bank of readout decimal counting units essentially paralleling totalizing function of basic counting instruments from which they operate, and a selecting relay matrix to channel information from counting circuits to (2) Printing Recorder which presents a sequence of total counts in direct-reading digital form on a standard adding machine tape.—*Berkeley Scientific Div., Beckman Instruments, Inc.*, 2200 *Wright Ave., Richmond, Calif.*

**Mention No. 1607 when filling out card.**

# TEMPERATURE

## Surface-temperature Indicator

New "Temp-Check" eliminates temperature troubles in close-tolerance measurement by measuring temperatures of either gage blocks or work, or of both. Standard model is calibrated from 60 to 100 deg. Fahrenheit; can be calibrated by placing probe in a constant-temperature reference next to bulb of a short-range laboratory thermometer and turning adjustment screw. Two flashlight batteries supply actuating current.—*Webber Gage Co.*, 12904 *Triskett Rd., Cleveland* 11, *Ohio.*



**Mention No. 1608 when filling out card.**

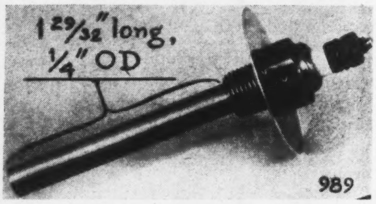
## Small Thermocouple Assembly

New "Type J" thermocouple assembly, originally developed for attachment to small (2-oz.) plastic molds, can also be used for measuring bearing temperatures, etc. It can be placed in die or mold so that measuring junction is as close as practical to cavity. Assembly consists of a 3/16-in. OD stainless steel protecting tube, available in lengths of 3, 4, 5, 6, and 8 in., with a 1/8-in. pipe thread compression fitting for attaching to mold, containing 20-gage Fiberglas-insulated iron-Constantan thermocouple. A flexible bronze armored tubing, in lengths of 4, 6 and 8 feet, with 1/2-in. pipe connection on its free end, is silver-soldered to protecting tube. —*Industrial Div., Minneapolis-Honeywell Regulator Co., Philadelphia* 44, *Pa.*

**Mention No. 1609 when filling out card.**

## Midget Thermostat

New midget "Thermoswitch," for temperature control or overheat detection applications where space is at a premium, is adjusted and sealed at factory to any set-point in range from minus 50 to 450 F.; has inherent sensitivity of 0.1 F.; is rated at 1 amp. at 48 volts ac. or 32 volts dc. Unit illustrated is an inverse compression type in which contacts close with temperature rise. Others available with a straight thread, with both regular and inverse contact arrangements.—*Fenwal Inc., Ashland, Mass.*



**Mention No. 1610 when filling out card.**

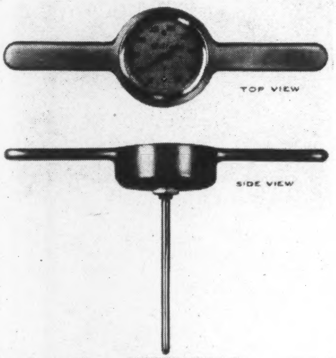
## Miniature Thermostat

New "VAL 90" miniature hermetically-sealed snap-action thermostat is ⅜ in. diam. x 15/16 in. long. One terminal is pin of eyelet hermetic header; cylindrical brass capsule is other terminal. Bimetal is thermally a part of capsule, hence quite sensitive to changes in temperature. Both temperature and differential are adjustable. Thermostat can be used without the capsule for on-the-job adjustment. Design permits close tolerances in setting and differential without delay in deliveries.—*Valverde Laboratories*, 252 *Lafayette St., New York* 12, *N. Y.*

**Mention No. 1611 when filling out card.**

### Side-handle Thermometer

New Handle Type Thermometer has hand grips on sides of dial; can be plunged into hot asphalt, foundry sand, chemicals, etc. without burning operator; is available in dial diameters of 4-3/4, 2-13/16, or 2-1/4 in. and stem lengths up to 72 in. Stem is of stainless steel; handle of cast aluminum. All popular Fahrenheit or Centigrade ranges. Guaranteed accuracy 1 percent of full-scale.—*W. C. Dillon & Company, Inc.*, 14620 *Keswick St., Van Nuys, Calif.*



**Mention No. 1612 when filling out card.**

### Midget Packing Gland

New "Model MPG" midget packing gland is designed as a standard seal for entry of small dial-type thermometers, thermocouple wells, Pitot tubes, static pressure probes, or even insulated electric lines. As a tube seal it may be used as a standard male connector for tube ends or as a standard compression fitting: soft sealant will not damage tube. Neoprene is standard sealant; asbestos graphite is optional for use with sliding or rotating rods and tubes. MPGs are available from stock for 3/32, ⅛ and 3/16 in. diameter instrument tubes. Intermediate diameters available on special order.—*Conax Corp.*, 4515 *Main St., Buffalo* 21, *N. Y.*

**Mention No. 1613 when filling out card.**

### Small-gage I-C Wire

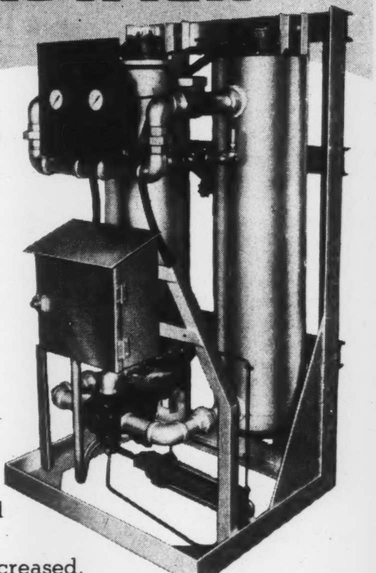
New weatherproof extension wire for maker's iron-Constantan thermocouples is of smaller gage, making it possible to increase total footage of wire which customers may obtain from alloy alloted to maker. It also enables users to install more wires per conduit. It can be used with all models of maker's electronic instruments, most of which are relatively unaffected by external resistance.—*Industrial Div., Minneapolis-Honeywell Regulator Co., Philadelphia 44, Pa.*

**Mention No. 1614 when filling out card.**

## PRESSURE

### Differential-pressure Transmitter

New "Type D2T Autronic" differential pressure transmitter, for use with maker's "Autronic Control System," covers a differential range of 0-20 in. to 0-200 in. water at static pressures up to 1500 psig. A corrosion-resistant stainless-steel diaphragm actuates,



**Keep Instrument Air CLEAN and DRY with an Industrol DYNAMIC DEHUMIDIFIER**

Backed by years of experience, INDUSTROL Dynamic Dehumidifiers have been especially designed to provide clean, dry instrument air, at low cost. With their use a drastic reduction of instrument maintenance is made possible. Costly instruments can last longer, operate at maximum efficiency.

Perfect heat distribution built into the design of these units assures excellent regeneration. To care for future needs, units are so designed that larger chambers can be installed with minimum effort and expense, should unit capacity need to be increased.

**Industrol DYNAMIC Dehumidifiers offer these advantages:**

- Simplicity of design
- Ease of installation
- Superior type of desiccant—easily replaced without dismantling unit
- Minimum maintenance
- Complete dependability
- Compact, economical, rugged
- Sizes—35 - 1500 cfm.
- Perfect regeneration—steam or electric

**SEND FOR** — new illustrated Bulletin DD-140 describing INDUSTROL Dehumidifiers and how to size a unit to fit your requirements.

Industrol Dynamic DEHUMIDIFIERS for Compressed Gases
Industrol

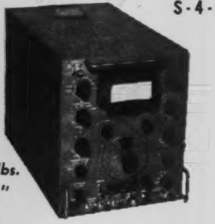
2081

**Industrol CORPORATION**

Subsidiary of
Trinity Equipment Corp.
494 Westfield Ave., East
Roselle Park, New Jersey

THE SAR
PULSESCOPE
® BY WATERMAN

MODEL
S-4-A



Weight 31.5 lbs.
9⅛" x 11¼"
x 17¼"

**Another example of WATERMAN pioneering, a compact, portable instrument for precision pulse measurements adaptable for all electronic work, including radar and TV. S-4-A SAR PULSESCOPE will portray all attributes of the pulse; such as shape, amplitude, duration and time displacement. In S mode of operation, the unit functions as a wide band oscilloscope, with optional video delay, in either repetitive or triggered sweep conditions. In A mode of operation the unit functions as a precision time measuring device, with internal crystal controlled markers available for self calibration. In R mode of operation a desired small segment of A Sweep is expanded to fill the face of the tube for detailed observation.**

Video Amplifier band pass up to 11 mc ... optional Video delay 0.55 μs ... Pulse rise and fall time better than 0.07 μs ... Video sensitivity of 0.5 p to p/inch ... S Sweep 80 cycles to 400 KC either triggered or repetitive ... A Sweep 1.2 μs to 12,000 μs, R Delay 3 μs to 10,000 μs ... Directly calibrated on a precision dial ... R Pedestal (or sweep) 2.4 μs to 24 μs ... A & R Sweep Triggers available externally ... Internal crystal markers of 10 μs ± 50 μs ... Built in precision amplitude calibration .. Operates on 50 to 1000 cycles at 115V AC.

WATERMAN PRODUCTS CO., INC.
PHILADELPHIA 25, PA.
CABLE ADDRESS: POKETSCOPE

WATERMAN PRODUCTS INCLUDE:

S-5-A LAB PULSESCOPE
S-10-B GENERAL POCKETSCOPE
S-11-A INDUSTRIAL POCKETSCOPE
S-14-A HIGH GAIN POCKETSCOPE
S-14-B WIDE BAND POCKETSCOPE
S-15-A TWIN TUBE POCKETSCOPE

Also RAYONIC Cathode Ray Tubes
RAKSCOPES and other equipment

WATERMAN PRODUCTS

through a friction-free amplifying linkage, a differential transformer which provides 0-0.5-volt 60-cycle a-c. signal output required for operation of other units in "Autronic" system. Features: anti-thrust pressure seal which transmits motion of diaphragm to signal-generating differential transformer and acts as a seal against high static pressure; spring for zero adjustment; linkage-ratio adjustment for coarse span; and electrical adjustment for fine span which does not affect zero adjustment. Weight 26 lbs.—*The Swartwout Co., 18511 Euclid Ave., Cleveland 12, Ohio.*

**Mention No. 1615 when filling out card.**

## Pressure Pickup

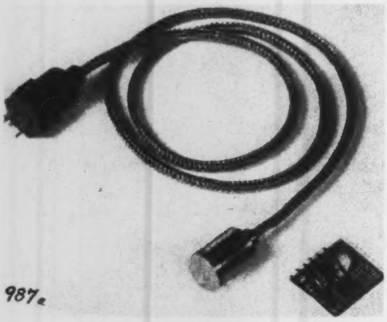
New "Model 503 Digitran" is smaller (1¼ x 1¼ x 4 in.) and lighter (7 oz.) than Models 501 and 502; uses same cycle-counting principle; has temperature control to 10 deg. F. with resultant output variation of 0.025 percent of bandwidth. Resolution is 0.02 percent and accuracy 0.1 percent. Hysteresis and repeatability errors, small enough to be masked by resolution, normally specified as 1 cps.—*Wright Engineering Co., Pasadena 1, Calif.*

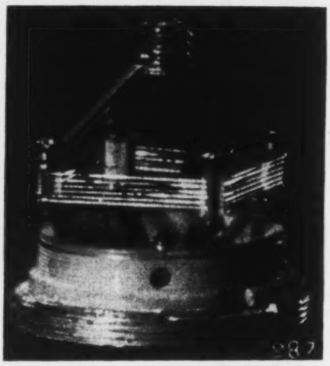
DIGITRAN
WRIGHT ENGINEERING CO

**Mention No. 1616 when filling out card.**

## Pressure Pickup

New "Type 4-310 Star" miniature pressure pickup measures 0.5 in. in diameter; has flush diaphragm for insertion directly into a process vessel or stream of either liquid or gas for test and monitoring purposes. Internal features are shown in Fig. 2. Active arms of 4-arm bridge are wound around vertical pins joining two star-shaped springs. Pressure on diaphragm deforms entire structure. Resultant spreading of pins stresses (and thus changes resistance of) two active arms to cause a bridge unbalance precisely proportional to pressure, while two inactive bridge arms, wound around base, are unaffected. Owing to geometry of spring-suspension system and arrangement of windings, acceleration effects are self-cancelling. Temperature compensation for zero drift over −65 to +165 F. range is provided. Response is accurate to frequencies as high as several thousand cycles per second, making new pickup applicable to studies of high-speed pumps and compressors.—*Consolidated Engineering Corp., Pasadena 8, Calif.*





**Mention No. 1617 when filling out card.**

## FLUID FLOW

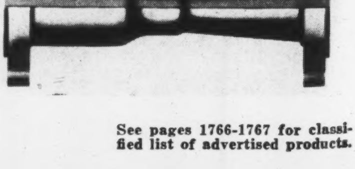
### Air Velocity Meter

New "Precision Air-Meter" operates on 110-v. 60-cycle supply, has intrinsic accuracy better than 1.5 percent and response time less than one second. Readings are unaffected by temperature variations, radiation, or normal fluctuations in atmospheric pressure. Two basic units:—(1) probe or measuring element, constructed entirely of noble metals to eliminate corrosion, contains no moving parts; (2) indicating unit, may be remotely located if desired, has a dual-range scale for air velocity measurement: 0 to 400 and 400 to 6000 feet per minute. The scale is expanded at low end to provide accurate readings of velocities as low as 5 fpm. One indicating unit can be used with as many as 25 probes by utilizing an accessory Selector and Balancing Unit. Remote and permanent installations may be employed. Instrument will give accurate readings with cable lengths up to 1000 feet; may be used with an external recorder; is available with a directional type probe or a horizontal non-directional probe. Special probes and special velocity ranges can be supplied.—*Hastings Instrument Co., Hampton 10, Virginia.*

**Mention No. 1618 when filling out card.**

### Saran-lined Venturi Nozzle

New "Model NZSL" Saran-lined Venturi Flow Nozzle is a Venturi styled differential producer for use in metering and controlling flow of corrosive fluids. Saran (product of Dow Chemical Co.) has been thoroughly

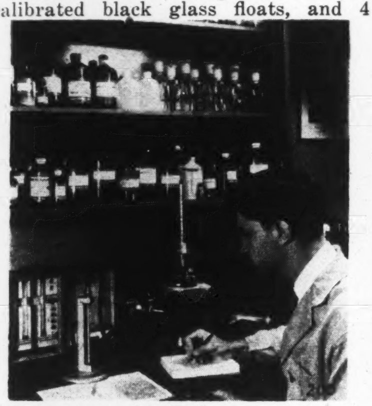


tested for corrosion resistance. "Model NZSL" allows wider use of continuous processes instead of "batch" processes, metering sulphuric acid, nitric acid, ethyl alcohol and other solvents including oils and latex.—*Builders-Providence, Inc.,* 345 *Harris Ave., Providence* 1, *R. I.*

**Mention No. 1619 when filling out card.**

### Wide-range Flowmeter Kit

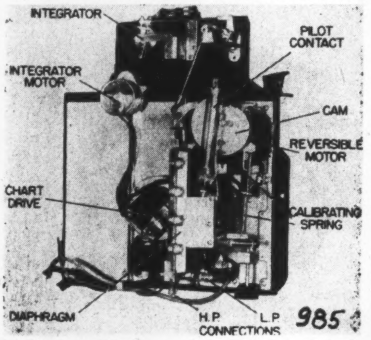
New portable variable-area flowmeter kit measures liquid or gas flow-rate with 4 interchangeable tubes, 2 calibrated black glass floats, and 4 calibrated steel-ball floats, all in one stand and case. Kit measures flow-rate of any liquid or gas that does not attack glass or stainless steel. Total range covered is 0.025 cc. to 2100 cc. per minute for liquids, 2 cc. to 38,000 cc. per minute for gases. Kit has stand, two serrated hose connectors. Tubes are accurately made of annealed Pyrex glass. —*Fisher Scientific Co.,* 717 *Forbes St., Pittsburgh* 19, *Pa.*



**Mention No. 1620 when filling out card.**

### Low-differential Flowmeter

New "Diaflow Meter" records low-differential air or gas flow-rates; is also available with two flow elements for recording flow ratios; utilizes pilot method of operation in which no load is placed on measuring element. Dry diaphragm type measuring element obviates need of liquids and of leveling.

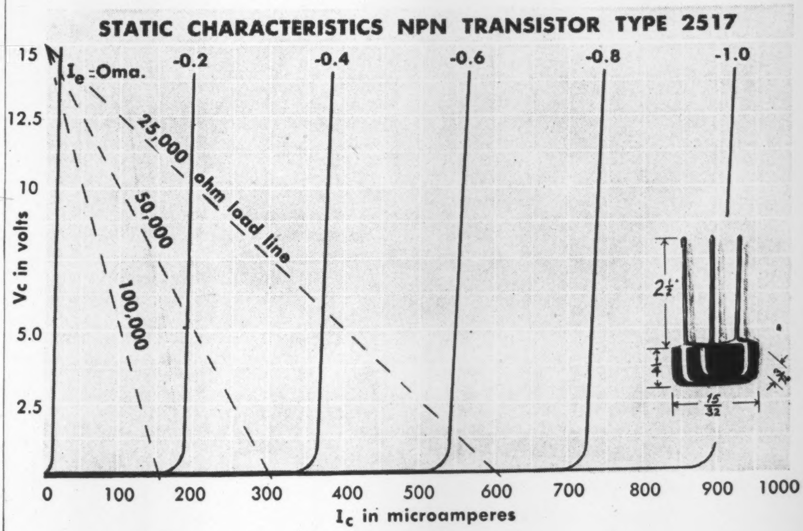


Features: Unit construction whereby parts can be removed separately or as a whole without affecting calibration; internal parts accessible from front of case for easy removal without special tools. Diaphragm unit accommodates static pressures up to 10 psi. and differentials up to 20 in. water; does no work other than to command a reversing motor which provides the power required for meter operation. This

NPN JUNCTION TRANSISTORS*

UNIFORM CHARACTERISTICS ASSURED

PRODUCTION QUANTITIES NOW AVAILABLE FOR IMMEDIATE DELIVERY



STATIC CHARACTERISTICS NPN TRANSISTOR TYPE 2517

PRODUCTION QUALITY CONTROL
assures interchangeability for mass production applications!

KEEP INFORMED
Important developments in the field of semi-conductors are occurring daily.
If you are not on our mailing list -- write us today!

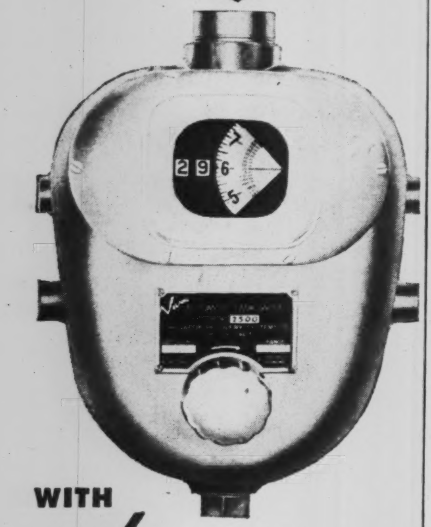
WATCH FOR ANNOUNCEMENTS!
- Junction diodes!
- Photo-Transistors!
- Germanium Power Rectifiers!

Federated
SEMI-CONDUCTOR CO.
EXCLUSIVE SALES AGENTS FOR
GERMANIUM PRODUCTS CORP.
66 Dey St. New York City 7, N. Y. DIgby 9-3050

5 Coast-To-Coast Sources Of Supply
- New York City 7, N. Y., 66 Dey St.,
- Newark, N. J., 114 Hudson St.,
- Allentown, Pa., 1115 Hamilton St.,
- Easton, Pa., 925 Northampton St.,
- Los Angeles 15, Cal., 911 So. Grand Ave.,

*Manufactured by the Germanium Products Corp. (*Under Western Electric Co. License)

Take the Guesswork out of Gauging



WITH

"Varec" Fig. No. 2500

AUTOMATIC TANK GAUGE

FOR ALL TYPES OF LOW PRESSURE TANKS

Easiest To Install. Read. Operate. Maintain.

No oil tank should be considered properly equipped without a dependable, gas-tight automatic Tank Gauge! The new "VAREC" Figure No. 2500 Automatic Tank Gauge can eliminate the many errors of hand gauging and will, in addition, permit a host of time and money saving advantages.

The Fig. No. 2500 is also adapted for installation of "VAREC" Electronic Remote Reading Gauging equipment and Electronic Hi-Lo Limit or Controller Switches. Write today for full information or send coupon below!

"Varec" THE VAPOR RECOVERY SYSTEMS COMPANY

2820 N. Alameda Street, P. O. Box 231
Compton, California, U.S.A.

MAIL COUPON NOW FOR NEW BULLETIN CP-3500

THE VAPOR RECOVERY SYSTEMS CO.
2820 N. Alameda Street, P.O. Box 231
Compton, California, U.S.A.

Company & Dept.__________

Name__________ Title__________

Street and No.__________

City and State__________

25-3

capacitor type motor, specially built for reversing duty, has a squirrel-cage rotor and a fully enclosed lubricated gear train, is unaffected by normal variations in voltage and frequency. A square-root cam provides an easily-read equal-increment flow record.—*The Hays Corp., Michigan City, Indiana.*

**Mention No. 1621 when filling out card.**

### Maximum Flow-rate Limit Signal or Shut-off

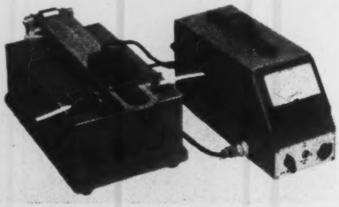
New "Max-Alarm System," for processes or equipment where flow-rate through a pipeline is not to exceed a given value, can operate a visual or audible warning signal, and also shut off a pump or close a motorized valve, when maximum limit is exceeded. Capacity of built-in relay is 8 amps. at 125 volts. Primary flow-measuring element used with new system is unaffected by pressure variations in measured fluid; can be used at pressures up to 20,000 psi. and at temperatures from 4 deg. Absolute to 1200 F. New system can be used with toxic or highly corrosive liquids, viscous fluids, liquefied gases, etc. One signal light indicates when power switch is on and instrument is operating; a second light flashes on only when flow-rate has exceeded maximum value. A reset button is provided for turning off warning light and resetting alarm relay after corrective action has been taken.—*Potter Aeronautical Co., 87 Academy St., Newark 2, N. J.*

**Mention No. 1622 when filling out card.**

## LABORATORY

### Densitometer for Paper Chromatography

New "Densichron" for quantitative paper chromatography is said to feature extreme sensitivity and stability (no drift); also no need of zero adjusting; a special paper guide and a voltage-controlled light source.—*W. M. Welch Scientific Co., 1515 Sedgwick St., Chicago 10, Ill.*



**Mention No. 1623 when filling out card.**

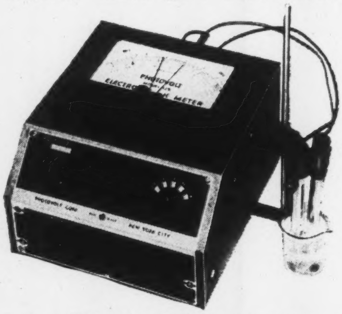
### Grating Monochromator

New grating monochromator of 500mm. focal length delivers light of extremely high intensity and spectral purity either for irradiation work in biological field or for use in ultraviolet microscopy, photochemistry or spectrophotometry. It produces light dispersed by a B&L "Certified Precision Grating" which has an efficiency of approx. 65 percent at 2650A. Light is condensed by a concave collimating-condensing mirror to exit slit and is collimated for all wavelengths. Grating has a ruled area 100mm. square, with either 600 or 1,200 grooves per mm., as ordered. Three light sources are available: (1) High-intensity mercury arc for ultraviolet microscopy; (2) Ribbon filament for visible region; (3) Hydrogen arc for work requiring continuous spectrum illumination in the ultraviolet. Optical system operates at a speed of f/4.4—*Bausch & Lomb Optical Co., Rochester, N. Y.*

**Mention No. 1624 when filling out card.**

### Portable pH Meter

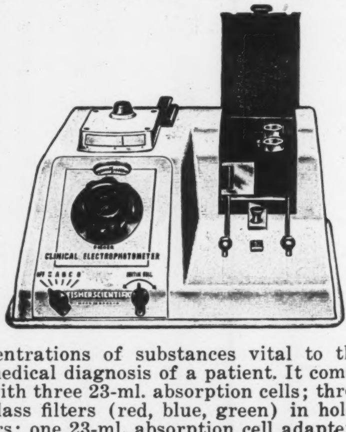
New "Model 125" low-priced portable pH meter features utmost simplicity: it works with 3 ordinary radio batteries, which give 2000 hours of service. This has been achieved by use of advanced designs of subminiature tubes and circuits, which also made possible a drastic reduction of number of electronic components. Operation and maintenance are simplified, while accuracy of 0.03 pH is insured. "Model 125" is primarily intended for battery operation, but a stabilized power supply unit can be furnished to operate it from a-c. power supply.—*Photovolt Corporation, 95 Madison Ave., New York 16, N. Y.*



**Mention No. 1625 when filling out card.**

### Photoelectric Color Comparator for Medical Diagnoses

New "Clinical Electrophotometer," and accompanying "Manual of Clinical Methods," enable a technician to measure color intensities which reveal concentrations of substances vital to the medical diagnosis of a patient. It comes with three 23-ml. absorption cells; three glass filters (red, blue, green) in holders; one 23-ml. absorption cell adapter; a storage box for filters and absorption cells; transparent covers for instrument and storage box; and the manual. —*Fisher Scientific Co., 717 Forbes St., Pittsburgh 19, Pa.*



**Mention No. 1626 when filling out card.**

See pages 1766-1767 for classified list of advertised products.

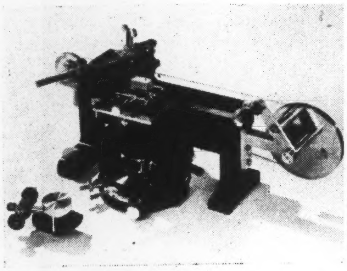
## Precision Torque Balances

New precision torque balances are particularly suitable for use where a large number of accurate weighings must be done. Rapidity of weighing is increased by a damping device which does not affect sensitivity. Models are available in capacities from 1 milligram to 20 grams with sensitivities ranging from 0.002 mg. to 0.02 mg. Among features: eye-level reading, resistance to shock, attractive stand enabling specific gravity weighing, and easy-reading device without vernier.—Made in Holland, stock, spare parts and service by *Ohaus Scale Corp.*, 1050 *Commerce Ave., Union, N. J.*

**Mention No. 1627 when filling out card.**

## Industrial Microtome

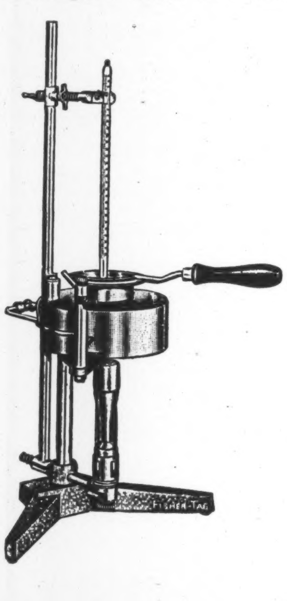
New industrial microtome (German-made) is said to be ideally suited for preparation of thin sections of synthetic materials, wood, fibres, rubber, resins, etc. Thickness adjustment is automatic, from 1 to 50 microns. Coarse adjustment is effected by a crank. Microtome can hold specimen measuring up to 50 x 25 mm. For rubber, etc., a freezing chamber can be furnished.—*William J. Hacker & Co.*, 82 *Beaver St., New York 5, N. Y.*



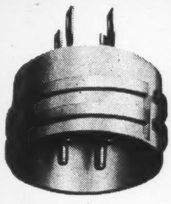
**Mention No. 1628 when filling out card.**

## Flash-point Testers

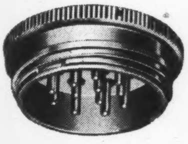
New gas model and two new electric models of Fisher-Tag Cleveland Open Cup Flash and Fire Point Testers have been redesigned. Each new model is



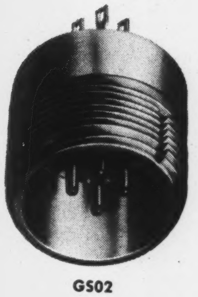
**CANNON PLUGS** *for hermetic sealed applications*



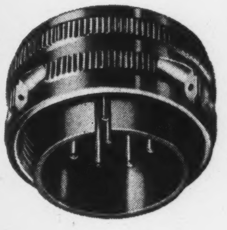
KH



RKH



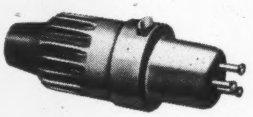
GS02



GS06

**HERMETIC SEALED** Type RKH Plugs and KH Receptacles mate with their corresponding Cannon RK and K standard fittings. The basic construction of fused vitreous insulation around the contacts is same as GS type. Shell materials and finish are likewise similar. Various types of flange or hex-bulkhead styles may be made to order.

Refer to KH-1 Section in K Bulletin.



**SUB-MINIATURE** receptacles of the new Cannon "U" Series are used on miniature switches, relays, transformers, amplifiers, and other sealed components, requiring a true hermetic seal or a connector of sub-miniature size with performance superiority.

"U" plugs have a steel shell and "SILCAN*" insulator, cable relief and moisture resistant sleeve.

Bayonet-type locking means prevents vibration failure. Rated 1700v. d.c.; 5a. Available in 3, 6, and 12 contact arrangements with one plug style and two receptacles.

**Cannon Electric's special silicone resilient material.*

Refer to U-2 Bulletin

GS Types mate with standard AN(MIL) types. These highly successful hermetically sealed plugs (GS06) and receptacles (GS02) pioneered this field and are top quality fittings. Fused vitreous insulation provides a true hermetic seal for relays, position indicators, etc. Shells are steel, finished in cadmium plate and bleached Iridite; coupling nut on plug is natural finish Dural. Eyelet or solder pot terminals.

Built to resist thermal shock, –300°F. to +600°F., surpassing MIL Spec. GS02 Types will withstand operation temperatures 400°F. to 600°F., and pressures as high as 200 to 900 psi; specials to 7500 psi. GS Types approximate AN voltage and current ratings. Wide range of AN layouts available.

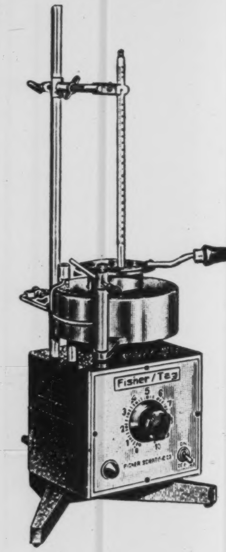
See GS-3 section in AN-8 Bulletin for details.

**COMING: TYPE "DH" HERMETIC SEALED CONNECTORS SIMILAR TO PRESENT DA-15P**

**CANNON ELECTRIC**

**Since 1915**

Factories in Los Angeles, Toronto, New Haven, Benton Harbor. Representatives in principal cities. Address inquiries to Cannon Electric Co., Dept. L-180 P.O. Box 75, Lincoln Heights Station, Los Angeles 31, Calif.



designed and constructed to meet ASTM specifications D92 for determining flash and fire points. Choice of models and means of heating depends upon the analyst's preference.—*Fisher Scientific Co., 717 Forbes St., Pittsburgh 19, Penna.*

**Mention No. 1629 when filling out card.**

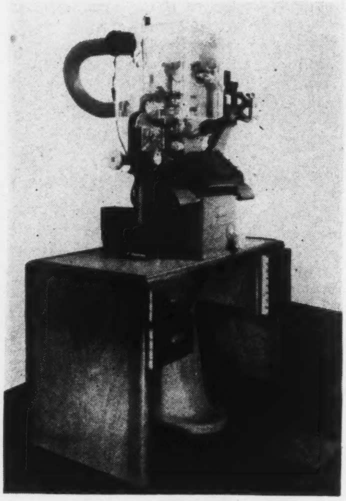
## Medical Radiation Detector

New "Model 1617 Isotron" is not like Princeton U's Isotron but is a console-type instrument permitting clinical use of radioisotopes for both diagnosis and therapy, incorporating a count-rate indicating circuit, a regulated high-voltage supply, a gamma-ray-sensitive probe, an arm for positioning probe, and a chart recorder to record counting rates. Controls on slanting top panel provide for selection of counting ranges, choice of time constants to achieve desired counting accuracy, and variation of high voltage. Switches control recorder. Operation is shown by pilot lights.—*Nuclear Instrument & Chemical Corp., 229 W. Erie St., Chicago 10, Ill.*

**Mention No. 1630 when filling out card.**

## All-purpose Industrial and Biological Microscope

New "Plenary Microscope" is said to be the most versatile microscope ever presented. It is the first commercial offering of a cinemicrographic unit having an incubated stage. Applications are not limited to living organisms, but include corrosion studies, growth of crystals, etc. Basic component is Vickers Projection Microscope (made in England) which alone permits many techniques, and which is available with or without incubator, motion-picture camera and almost every imaginable accessory.—*Lovins Engineering Co., 8203 Cedar St., Silver Spring, Md.*



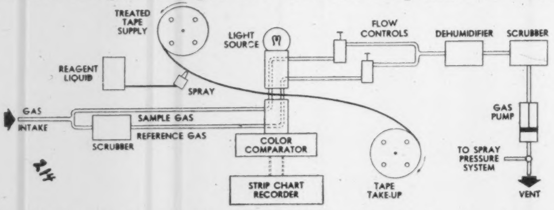
**Mention No. 1632 when filling out card.**

## Research Microscope

New Reichert (Austrian) "Zetopan" universal research microscope is equipped for examination in reflected light. Monocular-binocular tube permits instant changeover from binocular observation to micro-photography. Object stage is easily accessible to observer. Illumination is built-in. Binoc-

## Automatic Gas Analyzer

New "Microsensor" automatically detects and measures micro quantities of a gas or vapor. Operation depends on color reaction between gas or vapor being detected and chemically treated paper tape High sensitivity enables detection of industrial gases in quantities as small as 0.5 microgram per liter with full-scale indication. Changes in gas composition of 1 percent, in concentration as low as one ppm., can be measured for many gases. Operation is fully automatic. Additional features: alarm circuit to warn if gas exceeds predetermined quantity, continuous strip-chart recording apparatus, "fail-safe" warning signal if required. Uses are in petroleum refining and chemical manufacturing; health monitoring; and laboratory analysis and experimentation.—*Vitro Corp., of America, 233 Broadway, New York 7, N. Y.*



**Mention No. 1631 when filling out card.**

Need Help in a Hurry?

Remember

STEINEN

Mass Produces

SCREW MACHINE PRODUCTS

METAL STAMPINGS

ASSEMBLIES

- To Your Order
- To Close Tolerances
- To Cut Costs

STEINEN offers

1-High Speed, Automatic Screw Machines . . . Multiple & Single Spindle

2-High Speed Power Presses · Forming Presses; Welding, Brazing and Assembly Equipment

3-Complete Secondary Operation Facilities

4-Skill & "Know-How" of Trained Personnel

During the last war Steinen produced, and today Steinen is producing in larger volume than ever before—parts, sub- and complete assemblies for many of the leading manufacturers of aircraft, automotive, electronic, electrical, household appliances, instruments, machinery and metal products, oil burner nozzles and components, toys and novelties. You, too, can depend on their judgment as to Steinen quality, production economy and service.

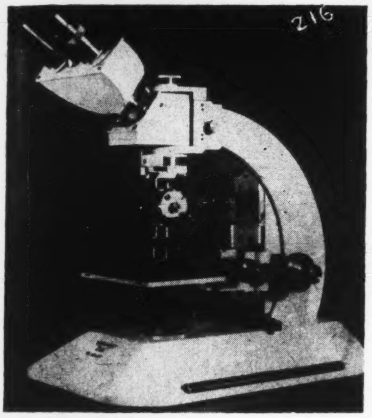
We invite your inquiries, whether for a hundred, a thousand or a million units.

STEINEN Quality Products

WM. STEINEN MFG. CO.

45 Bruen Street • Newark 5, New Jersey

See pages 1766-1767 for classified list of advertised products.

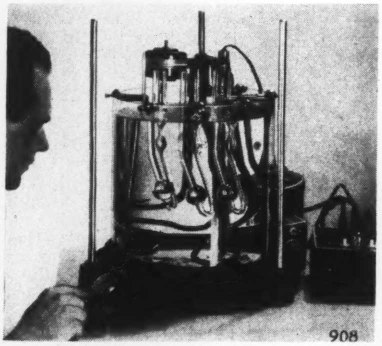


ulars revolve to permit three persons to witness image. Examinations possible in reflected or transmitted light; phase-contrast accessories available for transmitted light.—*Wm. J. Hacker & Co., Inc.*, 82 *Beaver St.*, *New York* 5, *N. Y.*

**Mention No. 1633 when filling out card.**

### Unitized Bath System

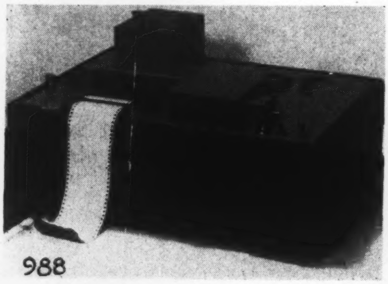
New "Unitized Bath" system of standardized parts enables laboratories to assemble constant-temperature baths of desired capacities and controls. (Illustrated example is a kinematic-viscosity bath for ASTM D445 tests.) As needs change, heaters, stirrers, thermostats and other standard components can be added.—*Fisher Scientific Co.*, 711 *Forbes St.*, *Pittsburgh* 19, *Penna.*


908

**Mention No. 1634 when filling out card.**

### High-speed Level Recorder

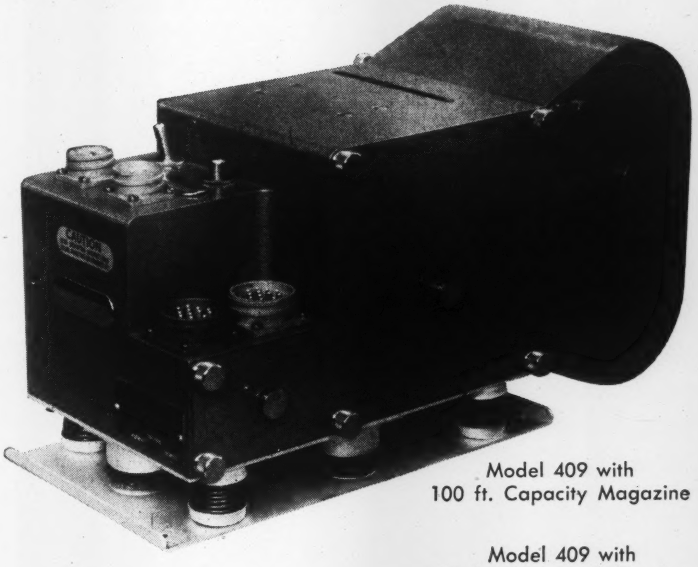
New "Model HPL High Speed Level Recorder" embodies electronic and mechanical design changes. Frequency response has been improved; sensitivity has been increased and can be adjusted


988

*Century* **MODEL 409**

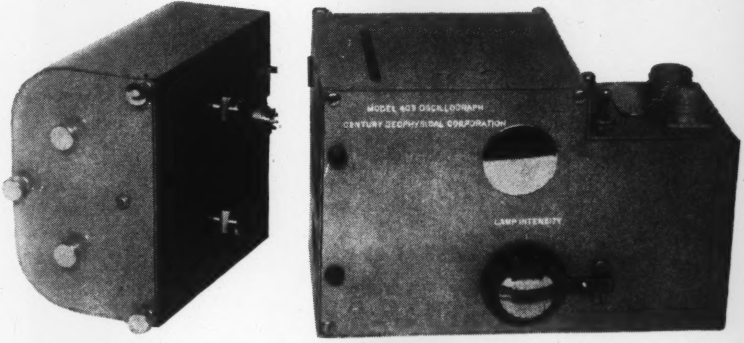
**RECORDING OSCILLOGRAPH**

**FOR VIBRATION, TEMPERATURE, STRESS, STRAIN ANALYSIS**



Model 409 with
100 ft. Capacity Magazine

Model 409 with
50 ft. Capacity Magazine



The Century Model 409 Oscillograph was designed for operation under the most adverse conditions and more especially, where space and weight considerations are limited.

This Oscillograph is the smallest and most compact unit available on the present market, yet it incorporates many features found in larger oscillographs, such as trace identification, trace viewing, continuously variable paper speeds and others. The Model 409 Oscillograph has been tested and proven to record faithfully during accelerations in excess of 20 g's. This makes it especially desirable for uses such as missile launching, parachute seat ejection, fighter aircraft and torpedo studies.

***Write for Bulletins CGC-303 and CGC-301***

*Century* **GEOPHYSICAL CORPORATION**
**TULSA, OKLAHOMA**

4447 No. Bodine
Philadelphia 40, Pa.

3406 W. Washington Blvd.
Los Angeles 18, Calif.

238 Lafayette St.
Dayton 2, Ohio

309 Browder St.
Dallas, Texas

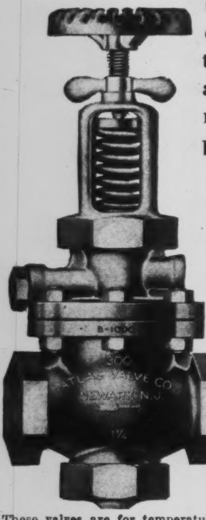
EXPORT OFFICE
149 Broadway, N. Y. City

ATLAS
STELLITED
STEAM
REDUCING VALVES

Type "B"

ATLAS TYPE "B," always a remarkable performer, is now a *much better* performer because it is STELLITED. The Pilot Valve is made entirely of that famous metal. The seat is STELLITE faced.

Try a Type "B" and you will find that it is unequaled for a service that demands tight seating and uniform reduced pressure.



For Bulletin 1-A, use the coupon below

Here we show Fig. 112 of Bulletin No. 1-A (Ask for a copy) for 300 lb. steam service. All Bronze—Screwed or Flanged Ends.—Pilot Operated. Sizes: ½" - ¾" - 1"-1¼"-1½"-2". For 250 lb. service we offer Fig. 114. Iron Body—Flanged Ends—Pilot Operated. Sizes: 2½"-3"-4"-5"-6"-8".

And for 400 and 600 lb. service see page 10 of Bulletin 1-A. These valves are for temperatures to 900° F. Steel Body—Nitralloy Piston and Stainless Steel Piston Chamber—Flanged Ends—Pilot Operated. Sizes: ½", ¾", 1", 1¼", 1½", 2" 2½", 3", 4".

Type "B" is simple to maintain. Main valve disc and pilot valve are easily removed for cleaning or regrinding. The entire pilot valve can be lifted out by merely removing diaphragm and unscrewing pilot valve seat.

ATLAS VALVE COMPANY
REGULATING VALVES FOR EVERY SERVICE

292 SOUTH ST., NEWARK 5, N. J.
*Represented in Principal Cities*

☐ Without obligation, please send me the ATLAS Regulating Valve Bulletin No. 1-A. Also please send complete information on the following ATLAS products:

☐ Damper Regulators
☐ Temperature Regulators
☐ Exhaust Control Systems
☐ Pressure Regulators
☐ Campbell Boiler Feed Water Regulator
☐ Pump Governors
☐ Oil Control Cocks
☐ Humidity Controllers
☐ Thermostats
☐ Balanced Valves
☐ Control Valves

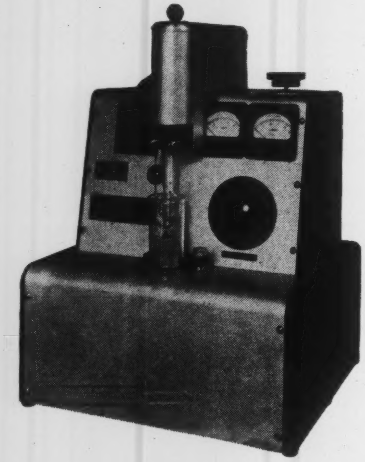
Name ..............................................
Firm ..............................................
Address ..............................................

from 7 to 12 millivolts. A new semiautomatic damping controls stylus and is particularly useful when input resistors or writing speed are changed. Electronic chassis can be easily substituted with circuits of different functions. Mechanical changes: more convenient chart roll insertion and chart setting; chart rewinding mechanism added; side knobs have been eliminated.—*Sound Apparatus Co., Stirling, N. J.*

**Mention No. 1635 when filling out card.**

### Metal Analyzer

New "Ultra-Speed Electro-Analyzer," though a single-position unit, has a production rate substantially equal to four positions on conventional apparatus. For example, in a copper assay, an analytically complete deposition of a one-gram copper sample is accomplished in eight minutes or less. Improved cell design, in combination with a unique electromagnetic field and greater current flow, produce increased speed.—*Eberbach Corp., Ann Arbor, Mich.*



**Mention No. 1636 when filling out card.**

### Counter Tubes

New metal gamma ray Geiger tube, said to be six times more sensitive to gamma radiation from radioactive iodine than other tubes of similar dimensions, contains a bismuth cathode; and has a standard four prong connector. Overall length, 8 in.; diameter, 1 in. A wide variety of metal cosmic-ray tubes said to possess excellent plateau characteristics are also now available for early delivery.—*Nucleonic Company of America, 497 Union St., Brooklyn 31, N. Y.*

Bismuth GM tube
Cosmic-ray tube
113

**Mention No. 1637 when filling out card.**

## TESTING

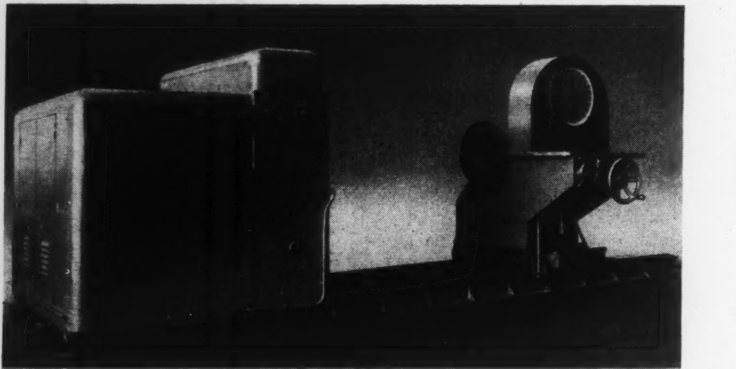
### Pocket Hardness Tester

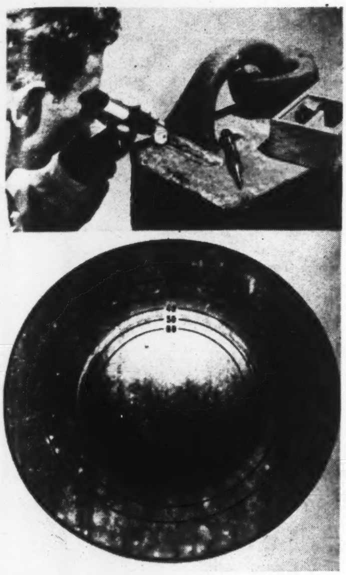
New low-cost pocket tester for determining hardness of steel alloys and other metals, in range of 25 to 65 Rockwell "C" scale, is a direct-reading device requiring no calculations. It includes a microball indentor, a measuring microscope and a standard hardness test block. Impact indentor drives a 1/16 in. tungsten carbide ball a short distance into specimen; diameter of

### Torsion-test Machine

New torsion machine for testing tool joints on oil well drill pipe measures torque to 600,000 in. lb. in either direction of twist; has two open chucks which permit running any length and size of drill pipe through machine. Torque is applied in two speed ranges: 1 to 6 rpm. for screw-up approach and 0 to 1 rpm. for "bucking up" tool joint. —*Baldwin-Lima-Hamilton Corp., Philadelphia 42, Pa.*

**Mention No. 1638 when filling out card.**



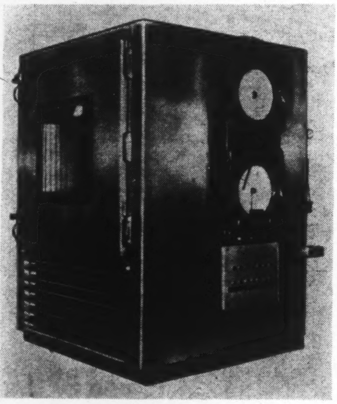


indentation is measured by reticulated microscope: reticle indicates the hardness directly with accuracy of plus or minus 1½ points "C" scale.—*Pacific Transducer Corp. of* 11921 *W. Pico Blvd., Los Angeles* 64, *Calif.*

**Mention No. 1639 when filling out card.**

### Temperature-humidity Test Chambers

New "TH Series" test chambers for conducting temperature-humidity tests are standardized in five basic chamber types with following inside dimensions in inches: (1) 22 x 19 x 48, (2) 42 x 18 x 48, (3) 36 x 31 x 36, (4) 42 x 24 x 48, and (5) 48 x 24 x 48. Models 1 and 3 have one door; others have two. All automatically maintain humidity from 20 to 95 percent through a temperature range of 35 F. to 185 F. Minimum dew point is 33 F.—*Tenney Engineering, Inc.*, 26 *Ave. B, Newark* 5, *N. J.*



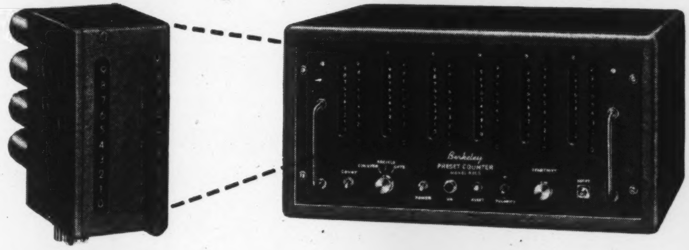
**Mention No. 1640 when filling out card.**

### Universal Testing Machine

New "Model FGT Baldwin-Emery SR-4" testing machine is said to be a totally new type of universal testing machine, incorporating an electric weighing system based on "SR4" re-

*Now...*
COUNTING
**PLUS** CONTROL
AT RATES TO
40,000 CPS
WITH

*Berkeley* PRESET COUNTERS



**DESCRIPTION**—The Berkeley Preset Counter is an electronic decade with provisions for producing an output signal or pulse at any desired preset count within the unit's capacity. Any physical, electrical, mechanical or optical events that can be converted into changing voltages can be counted, at rates from 1 to 40,000 counts per second. Total count is displayed in direct-reading digital form. Presetting is accomplished by depressing pushbuttons corresponding to the desired digit in each column. Model 730 Preset Decimal Counting Units are used. These are completely interchangeable plug-in units designed for simplicity of maintenance and replacement.

**APPLICATIONS**—Flexibility and simplicity of operation make the Berkeley Preset Counter suitable for both production line and laboratory use. It has practical applications wherever signalling or control, based on occurrence of a predetermined number of events or increments of time is desired. Output signals from the unit can be used to actuate virtually any type of process control device, or to provide aural or visual signals.

| **SPECIFICATIONS** | **Model** | | | | |
|---|---|---|---|---|---|
| | 422 | 423 | 424 | 425 | 426 |
| MAX. COUNT CAPACITY | 100 | 1000 | 10,000 | 100,000 | 1,000,000 |
| INPUT SENSITIVITY (MIN.) | ± 1 v. to ground, peak; at least 2 μ sec. wide | | | | |
| OUTPUT | Choice of pos. pulse and relay closure, or pos. pulse. SPST relay closure approx. 1/30 sec; pulse output is + 125 v. with 3 μ sec. rise time and 15 μ sec. duration. | | | | |
| PANEL DIMENSIONS | 15⅝" x 8¾" | | 19" x 8¾" | | |
| OVERALL DIMENSIONS | 16⅝" x 10¼" x 13" | | 20¾" x 10½" x 15" | | |
| POWER REQUIREMENTS | 117 v. ± 10% @ 90w. | | 117 v. ± 10% @ 180 w. | | |
| PRICE (F.O.B. FACTORY) | $375 | $450 | $595 | $695 | $795 |

M3

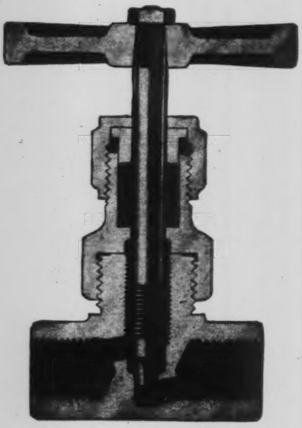
*For complete information, please request Bulletin 6012*

*Berkeley Scientific*
*division of* BECKMAN INSTRUMENTS INC.
2200 WRIGHT AVENUE • RICHMOND, CALIFORNIA

"DIRECT READING DIGITAL PRESENTATION OF INFORMATION"

DRAGON
announces—

A new forged steel body, high pressure, low priced needle valve, for both safety and economy.



CONSTRUCTION:

Threads regulating valve stem travel are machined in **valve body**, not in valve bonnet as in ordinary bar stock needle valves.

Valve bonnet has an unusually deep packing space, and functions only as a valve stem guide and packing reservoir, and has no relation to valve stem travel.

The removal of valve bonnet in the ordinary bar stock needle valve, either by galding or twisting off of valve bonnet threads, releases line pressure due to valve stem and valve bonnet being an integral unit.

In the DRAGON FORGED STEEL BODY NEEDLE VALVES, valve stem in a closed position will provide a positive fluid shut-off with **valve bonnet entirely removed from valve body.**

Available in carbon steel, and various types of stainless steel.

Valves have a working pressure 4,000 lbs., non shock, cold water, gas or oil.

**Fig. #10-F** Valves have **Forged** carbon steel bodies, steel valve bonnet, packing nut and gland; all cadmium plated to resist corrosion. Valve stem of cold drawn Stainless Steel.

**Fig. #20-F** Valves have **Forged** type 416 stainless steel bodies, all other parts are machined of type 416 stainless steel.

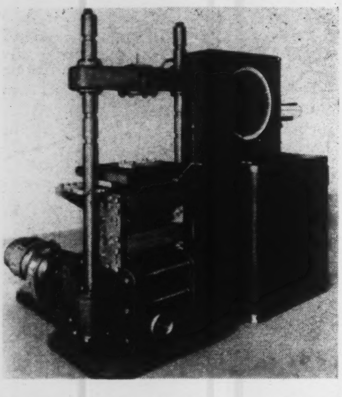
**Fig. #30-F** Valves have **Forged** 18-8 Stainless Steel bodies. All other parts are machined of Type 303 Stainless Steel.

**Fig. #31-F** Valves have **Forged** 18-8 Mo. (Type 316 Stainless Steel) bodies. All other parts are machined of Type 316 Stainless Steel.

All **Forged** valves have malleable Tee handles

**Also available in panel mounting**

**DRAGON ENGINEERING CO.**
**5817 So. Central Ave.,**
**Los Angeles 11, Calif.**



sistance wire strain gages in load cells at base of two vertical tie rods. Capacity is 50,000 lbs. Among characteristics: (1) Accuracy and sensitivity 0.2 percent of reading; (2) High-speed response of indicator or recorder to dynamic as well as static loads; (3) Extreme structural stiffness and lateral rigidity; (4) Wide range of loading speeds under precise stepless control: standard loading speed is 0.025 to 9.0 inches per minute; (5) Automatic load control for maintaining constant load, constant strain, constant rate of loading, or constant strain rate, thus enabling determination of creep, rupture, and relaxation properties of materials; (6) Automatic reversals of load, i.e., tension to compression to tension; (7) Quick-acting, semi-automatic operation for production testing; (8) Printing of critical test values included when desired; (9) Adaptability to stress analysis of parts and components of structures on which "SR-4" strain gages or brittle coating techniques are utilized.—*Baldwin-Lima-Hamilton Corp., Philadelphia 42, Pa.*

**Mention No. 1641 when filling out card.**

## SHOP

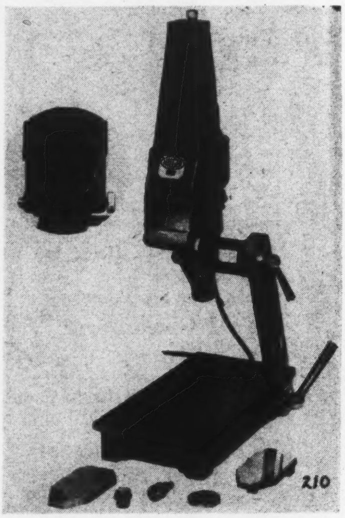
### Optical Tooling Instrument

New "Align-A-Scope" has been designed for new method of tooling and aligning by telescope. Basic lines of sight are established between ends of objects to be aligned, together with parallel auxiliary lines and targets. Telescope eyepieces are used either parallel or at right angles to line of sight, rotable to 360 degrees. An optical micrometer built in "Align-A-Scope" can displace line-of-sight either vertically or horizontally. Operating dials control and indicate this displacement (plus or minus). Instrument weighs 18 pounds. Auto-collimators, targets, bases, mounts, etc., are available.—*Joel Fox Co., Inc.,* 1110 *N. Seward St., Los Angeles* 38, *Calif.*

**Mention No. 1642 when filling out card.**

### Projection Auto-collimator

New "Projection Angle Dekkor" is auto-collimating unit for high-volume production, which shows on projection screen direct readings of squareness of a reflecting surface placed in path of its light. Does not show image of outline or surface of object being tested, but reflection from its surface produces an image of a built-in scale or graticule showing squareness of surface tested. Reflectors are available for difficult inspection jobs such as squareness of holes to reference surfaces, parallelism of two or more bores, etc.—*Engis Equipment Co.,* 431 *S. Dearborn St., Chicago* 5, *Ill.*



**Mention No. 1643 when filling out card.**

### Optical Inspection Instrument

New "Inspectoscope," optical magnifying device for inspection of tools, gages and mass-produced components, may also be used in projection of 35 mm. filmstrips, 2 x 2 in. slides and micro-slides; is designed for use by

See pages 1766-1767 for classified list of advertised products.

targets.
either
line of
An op-
lign-A-
t either
erating
isplace-
rument
mators,
avail-
N. Se-

t card.

ator

xor" is
volume
jection
ness of

ath of
f out-
tested,
oduces
ticule
tested.
lt in-
ss of
lelism
Engis
St.,

card.

agni-
tools,
nents,
of 35
and
e by

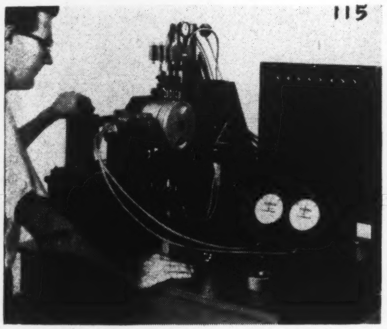
classi-
ducts.

shop worker as well as inspection specialist. Large gages or components can be inspected sectionally by moving instrument across object. Routine inspection during a run enables a tool setter to detect faults due to edge blunting or tool movement; and faults may then be rectified on the spot, saving inspector's time and eliminating waste of materials. "Inspectoscope" is said to be ideally suited for inspection of filaments, gauzes, threads, fibers, fibrous woven materials; also pivot points, etc.; also seeds, grains, etc. "Inspectoscope" weighs approx. 20 lbs. Lamp operates from regular electric supply or from a 12-v. battery, Objective lens is a 3-inch focal length, hard-coated anastigmat f3, which provides magnification up to 50X (for normal use 25X is recommended).—*International Standard Trading Corp., 22 Thames St., New York, N. Y.*

**Mention No. 1644 when filling out card.**

## Multi-dimension Gage

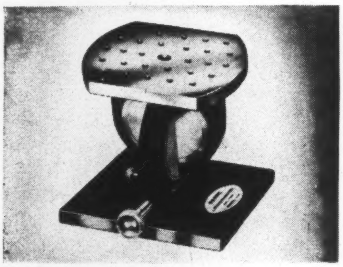
New "Model 236 B-984" multi-dimension gage measures all critical diameters of automotive and aircraft pistons. With dual-measuring air plug vertical, operator loads piston and checks both ends of wrist pin hole for I.D., taper and bellmouth. Air plug is then rotated 180 deg. to explore for out-of-round. Variation from master setting is indicated by "Dual Dimension-air" (right, foreground). As gage handle is pushed forward, piston takes a horizontal position between contacts. Here all O.D.'s are simultaneously inspected by eight floating gage units and off dimensions are shown on "picture panel." Red lights show oversize; amber, undersize.—*Federal Products Corp., 1144 Eddy St., Providence, R. I.*



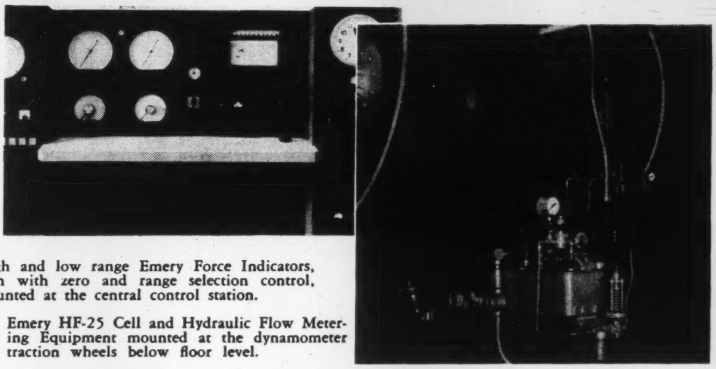
**Mention No. 1645 when filling out card.**

## Angle Computer

New "Derry Angle Computer" measures any simple or compound angle within a hemisphere on two protractors graduated to a tolerance of three sec-



# EMERY SOLVED THIS WEIGHING PROBLEM



High and low range Emery Force Indicators, each with zero and range selection control, mounted at the central control station.

Emery HF-25 Cell and Hydraulic Flow Metering Equipment mounted at the dynamometer traction wheels below floor level.

## FOR THE RICHMOND LABORATORIES
### of the California Research Corporation, a wholly-owned subsidiary of the Standard Oil Company of California

**THE PROBLEM:** Determine the tractive force exerted by automobile driving wheels at all simulated road speeds.

**THE SITUATION:** Accurate, easy-to-read indication needed up to 2,500 pounds, with extra accuracy below 500 pounds. Remote indication needed as the dynamometer is mounted below floor level with the control station above and at a distance. Measurement must be accurate despite strong vibration through load range, and must remain accurate despite possible heavy shock loads.

**THE SOLUTION:** Emery Hydraulic Flow Weighing System. An HF-25 Cell is mounted under the torque arm of the dynamometer to "weigh" the power absorbed. Flow control equipment is mounted on a convenient nearby surface.

**A CHOICE OF 0-500 or 0-2,500** pound Emery Bourdon Indicator is offered the operator. The low range indicator is marked in one pound steps, while the high range indicator is marked at five pound steps. Indicators are mounted with zeroing controls and range selection switches at the central control station.

**FOR HIGHEST ACCURACY** the entire Emery System was pre-calibrated under conditions similar to those of the Richmond operation, and shipped ready to be installed by the customer. Error at each indicator is less than 2/10 of 1% of the entire range.

## LET EMERY SOLVE YOUR WEIGHING PROBLEM

**AT LOW COST** for purchase and operation.

**WIDE RANGE** of stock sizes of Emery Closed Hydraulic, Hydraulic Flow, and Pneumatic Cells permit precision measurement of one to 100,000 pounds. Also special sizes up to 10,000,000 pounds.

**WRITE TODAY FOR ALL THE FACTS** on how Emery can solve YOUR Force Measuring Problem in Precision Weighing . . . Brake Testing . . . Torque or Torsion Measurements . . . Cable, Chain, or Rope Testing . . . Strength of Materials or Structures . . . Jet Engine Thrust . . . Towing or Traction Tests . . . or some unusual application of your own. Emery Engineers will welcome your most difficult weighing problem.

**THE A. H. EMERY CO.** **NEW CANAAN 3, CONNECTICUT**

Please send literature on Hydraulic Weighing ( ) TEL. NEW CANAAN 9-9595
Pneumatic Weighing ( )

Our problem is:____________________
____________________
____________________

Max. load__________ % Accuracy required__________
Max. permitted response time lag__________
NAME__________
POSITION__________

THE A.H. EMERY CO. PRECISION SINCE 1872 FORCE MEASUREMENT

(Please attach to your business letterhead)

"SERV-RITE"

Insulated Thermocouple Wire
Extension Lead Wire
FOR

PLATINUM COUPLES
CHROMEL ALUMEL
IRON CONSTANTAN
COPPER CONSTANTAN
IRON CUPRONEL

No matter what your wire or insulation requirements may be, you can depend on Gordon "Serv-Rite" insulated wire for pyrometers—recognized as a standard of highest quality for nearly half a century. All "Serv-Rite" wire is now manufactured in the new, completely modern Gordon plant, employing up-to-date equipment and machinery, supervised and operated by skilled technicians—your guarantee of continued precision quality. In addition to maintaining large stocks of all common types of wire, Gordon will manufacture special insulation, in long or short runs, to suit your individual needs and meet your most rigid specifications.

All Types of Insulation

Felted Asbestos
Asbestos Braid
Weatherproof Braid
Glass Braid
Polyvinyl Plastic
Nylon Braid
Stainless Steel Armored Braid
Silicone Treated
Cotton Braid
Lead Jacket

The home of "SERV-RITE"

Full Particulars on Request

4229

GORDON SERVICE

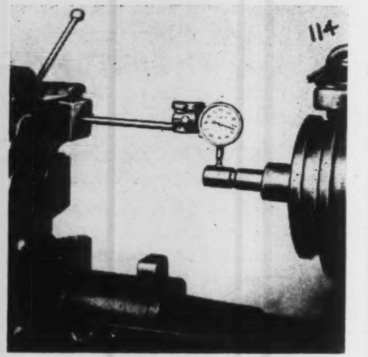
CLAUD S. GORDON CO.
Manufacturers & Distributors
Thermocouple Supplies • Industrial Furnaces & Ovens
Pyrometers & Controls • Metallurgical Testing Machines
Dept. 21 • 3000 South Wallace St., Chicago 16, Ill.
Dept. 21 • 2035 Hamilton Ave., Cleveland 14, Ohio

onds of arc. Clutch-type lock secures a precision angular position for job operation: by pulling vernier release pin, instrument can be set to any desired angle; then, to obtain a precision setting, re-insert pin and use key for precision adjustment. Thirty-day delivery.—*Scientific Engineering, 11126 Weddington, North Hollywood, Calif.*

**Mention No. 1646 when filling out card.**

## Magnetic Base

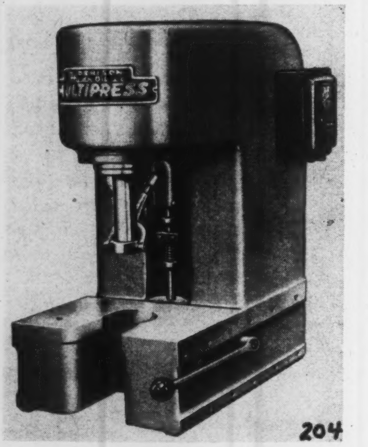
New magnetic base clings to any ferrous metal surface, flat or curved; can be used with height gages and dial indicators, or as a miniature chuck for small, precision work, or to hold work in position on surface plates for layout. —*Main Electric Co., Rochester, N. Y.*



**Mention No. 1647 when filling out card.**

## Press Control

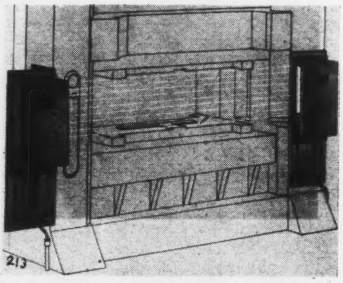
New "Touch Control" for maker's "Multipress" is a servo-type valve in hydraulic press circuit that gives "instant response" ram action controlled by hand-control lever. Minimum ram stroke is 1/16 inch; maximum, 6 to 15 inches. Control gives operator "feel" of work. Pressure gage on press indicates force needed. Device offers controllability for varying conditions of die fill, material thickness, etc., as well as straightening, lab testing, and assembly.—*The Denison Engineering Co., Dublin Rd., Columbus 16, Ohio.*



**Mention No. 1648 when filling out card.**

## Photoelectric Power-press Safeguard

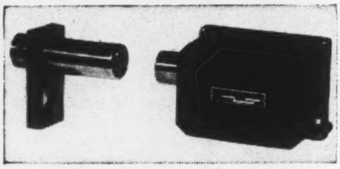
New "Curtain of Light" is photoelectric safety guard for power presses. Projector throws broad beam of light across danger zone. Should any obstruction enter during closing stroke, equipment immediately stops press, thereby protecting operator. Press operator works unhampered and fully protected; extra time is gained for preparation and loading. Performance is unaffected by line-voltage fluctuations. Electronic chassis is shock mounted.—*Electronic Control Corp., 1573 E. Forest Ave., Detroit 7, Mich.*



**Mention No. 1649 when filling out card.**

## Photoelectric Control

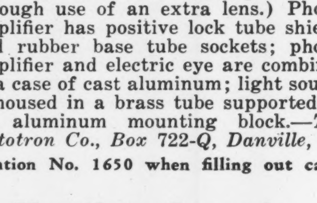
New "Shadowswitch" permits actuation of electric counters and other devices directly in plate circuit instead of through conventional plate circuit relay. Among advantages: (1) Much higher counting speeds; (2) service life of counters increased "tremendously." Light beam which can be focused for interruption by objects as small as 3/16 inch in diameter. (Sharper focus through use of an extra lens.) Photo-amplifier has positive lock tube shields and rubber base tube sockets; photo-amplifier and electric eye are combined in a case of cast aluminum; light source is housed in a brass tube supported by an aluminum mounting block.—*The Autotron Co., Box 722-Q, Danville, Ill.*



**Mention No. 1650 when filling out card.**

## Magnifying Spectacles

New magnifying spectacles leave both hands free, employ same optical system as a pair of binoculars, afford 2X magnification with exceptional clar-



See pages 1766-1767 for classified list of advertised products

ity and an unusually large field (as large as a magazine page) observed at a normal reading distance. They weigh hardly more than ordinary spectacles; can be folded and carried in their case; can be comfortably worn over regular glasses.—*Armco Mercantile Co., Room 134, 221 N. La Salle St., Chicago 1, Ill.*

**Mention No. 1651 when filling out card.**

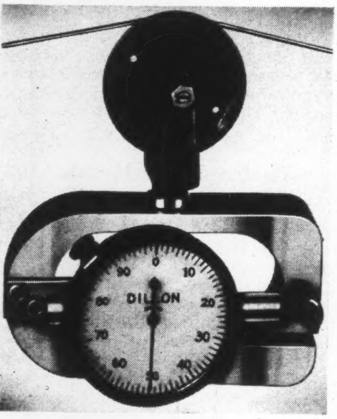
### Tension Regulator

New hysteresis brake that holds constant tension on yarn, wire, etc. by magnetic drag instead of friction, consists of Alnico magnets so designed and mounted that a magnetic drag restrains a pulley. This force is essentially constant at all speeds (up to 700 yards per minute) and can be adjusted by turning calibrated head mounted above pulley. Abrasion on yarn is minimized because yarn is always in contact with revolving pulley, not rubbed or drawn over surface. Device reverses direction of rotation a few degrees after stopping, thereby holding stalled tension. Inertia of the brake itself is slight enough that yarn does not become unthreaded during quick acceleration and deceleration. Tension control ranges from 3.5 to 10.5 grams.—*Control Dep't, General Electric Co., Schenectady 5, N. Y.*

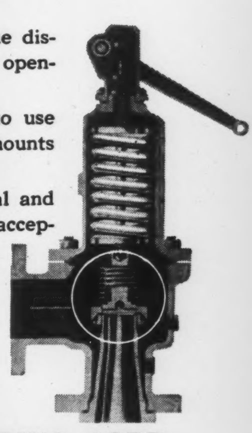
**Mention No. 1652 when filling out card.**

### Tension Gage

New addition to maker's "Mechanical Pressure Gauges" indicates in pounds the tension in a moving or stationary cable, plastic filament, yarn, paper, twine, etc. A ball-bearing sheave is mounted in a yoke which is screwed to a U-shaped pressure bar of heat-



Who's Kidding Who?



**YOU'RE kidding YOURSELF if you think every safety valve is equally safe.**

We know of one case where inspection showed that 27 out of 36 safety valves were stuck tight—*would not have operated at pressures far above the set point*—yet the user of those valves *thought* he had protection. He *could* have been stuck right along with those 27 valves.

If you want 100 per cent safety—and you'd hardly want less—there's one sure way to get it—specify BalanSeal or FarriSeal Safety Valves.

**Why?** Because they *can't* stick, plug or corrode. Critical working parts are permanently isolated from any contact whatever with the lading.

Because they're unaffected by back pressures in the discharge manifold due to its own operation or to the opening of other valves in the line.

Because these features make it possible for you to use smaller discharge piping, an economy which often amounts to substantially more than the cost of the valves.

You'll be interested in the engineering of BalanSeal and FarriSeal Valves—design which is rapidly gaining acceptance in hundreds of successful installations.

**Ask for our "8-Minute Brief."**

1189 R

**Your Safety's REAL**
**With FarriSeal**

**Farris ENGINEERING CORP.**
**436 COMMERCIAL AVE., PALISADES PARK, N. J.**

**AFFILIATES**
Farris Stacon Corp. *Temperature Regulators* • Farris Flexible Valve Corp. *Pinch Type*
Farris Hydrotorque Corp. *Remote Controls* • Farris Hydroseal Corp. *Elastic Piston Seals*

HERE ARE THE WINNERS

in the "WIN WITH HONEYWELL" CONTEST

The plurality, as published in the New York Times of November 6th, was 6,189,974.

**$100. bond to:**

Frank R. Innes
*Electrical World*
New York, N. Y.

**$50. bond to:**

F. A. Braghetta
*Mare Island Naval Shipyard*
Vallejo, Calif.

**$25. bond to:**

Fred J. Brockman, *Kentucky Synthetic Rubber Corp.*, Louisville, Ky.
Wilbur F. Yocum, *USN Eng. Exp. Station*, Annapolis, Md.
John Franz, *J. M. Lehmann Co.*, Lyndhurst, N. J.
O. B. Yoder, *Aluminum Company of America*, Davenport, Iowa
J. B. Shafer, *Socony-Vacuum Oil Company*, Trenton, Mich.
John L. Kaperak, *Havens & Emerson*, Cleveland, Ohio
Stephen N. Stilwell, *General Electric Co.*, Reading, Ohio
George C. Bean, *Bean Engineering Service*, South Euclid, Ohio
Harvey W. Rogers, *Celanese Corporation of America*, Newark, N. J.
W. C. Williams, *Purchasing News*, Detroit, Mich.
Ruth H. Bross, *Metals Disintegrating Co.*, Elizabeth, N. J.
Arlie F. Niswander, *Boice Payett Lumber Co.*, Emmett, Idaho
H. T. Stone, *United Engineers & Constructors, Inc.*, Philadelphia, Pa.

**MINNEAPOLIS-HONEYWELL REGULATOR CO.**
*Valve Division, Philadelphia, Pa.*

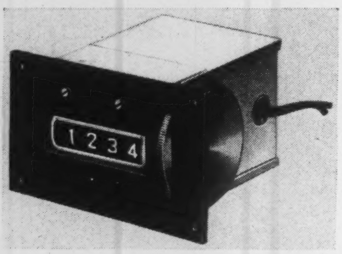
MINNEAPOLIS
Honeywell
VALVE PRODUCTS
First in Controls
H HONEYWELL

treated alloy steel. Under downward pressure of filament, bar deflects 0.039 in. for a full-scale reading. Accuracy is guaranteed to within 1 percent of indicated reading. A threaded mounting hole is provided in bottom half of U bar. A maximum pointer is available optionally. Available capacities: 10, 25, 50, 100, 250, 500, 1000, 2500 or 5000 pounds. Shockless versions are also offered.—*W. C. Dillon & Co., Inc.*, 14620 *Keswick St., Van Nuys, Calif.*

**Mention No. 1653 when filling out card.**

## Small Electric Counter

New small 4-digit electric counter features convenient panel mounting and front-of-panel reset. Requiring a panel opening 2-13/16 x 1-11/16 in., instrument is inserted from front and attached by four screws. With a current draw of about 3 watts, it may be operated in plate circuit of electron tubes as well as actuated by any switch, relay, etc. Normally rated at 600 cpm., it is being operated in electronic circuits at speeds up to 1800 cpm.—*Production Instrument Co., 702 W. Jackson Blvd., Chicago 6, Ill.*



**Mention No. 1654 when filling out card.**

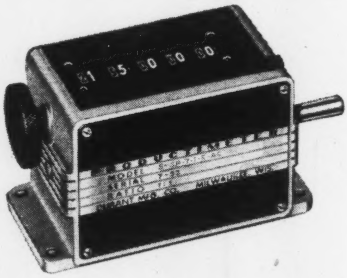
## Electric Counters with Built-in Rectification

New "Wizard Electric Counters" for a-c. service have a rectifying unit built into counter without change in counter dimensions, which prolongs service life from around 150 million counts to 350 million counts. New counters with built-in rectification are available for 115 and 230 volts a.c. in standard, panel-mount and dustproof types; four- and six-digit models, knob reset or key reset.—*Production Instrument Company, 702 W. Jackson Blvd., Chicago 6, Ill.*

**Mention No. 1655 when filling out card.**

## Predetermined Counters

New "SP" small predetermined "Productimeters," for stroke and rotary application, are entirely enclosed for protection against dust and moisture. Over-all dimensions 4-⅜ in. wide by 2-⅛ in. deep by 2-⅝ in. high. Weight 1-¾ pounds. Rotary type (illustrated) is available for clockwise or anti-clockwise rotation, right or left hand drive. Predetermined count up to 99,999.—*Durant Mfg. Co., 1914 N. Buffum St., Milwaukee 1, Wis.*



**Mention No. 1656 when filling out card.**

## Noise Analyzer

New "Type 420-A Sound Analyzer" separates noise, sound and vibration signals into their component frequency bands. High- and low-pass filters can be independently adjusted in half-octave steps. Pass-band width can be fixed in any multiple of half an octave; position of this pass-band can then be adjusted throughout audible range by a single control. Analyzer is said to exceed all proposed ASA specifications for filter-type sound analyzers. It may also be used as an amplifier having a range exceeding 20 to 20,000 cps.—*Hermon Hosmer Scott, Inc., 385 Putnam Ave., Cambridge 39, Mass.*

**Mention No. 1657 when filling out card.**

## Tachometer Heads

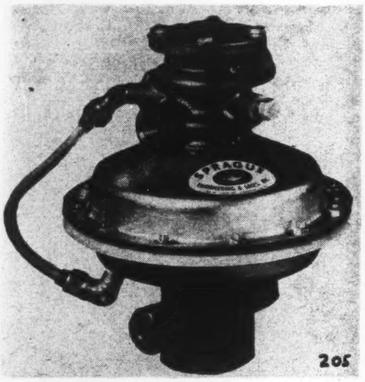
New "Series 57M" heavy-duty tachometer heads for measuring speeds as low as a fraction of a revolution per minute are suitable for extruders, welders, kilns, ovens, dryers, etc. Speeds up to 199 rpm. for full-scale indication can be measured. Overspeeding up to 10 times rating results in no damage.—*Metron Instrument Co., 432 Lincoln St., Denver 9, Colo.*

**Mention No. 1658 when filling out card.**

See pages 1766-1767 for classified list of advertised products.

### Hydraulic Boost Pump

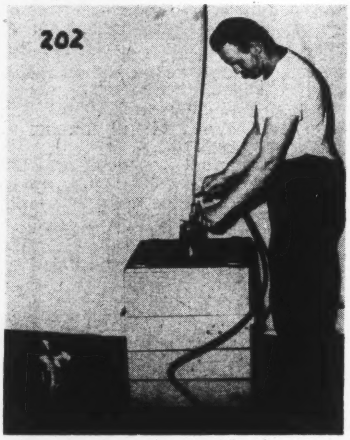
New "Model S-216-C" air-operated hydraulic boost pump for high-pressure work will pump mercury, power presses for metal forming, shearing, clamping, etc. Six standard models for output fluid pressures to 30,000 psi. from 100 to 150 psi. plant-supplied air pressure. Capacities to 50,000 psi. on special order. Operates automatically on principle of differential areas. Pressures controlled by regulation of air inlet pressure. Weight is 20 lbs.—*Sprague Engineering & Sales Corp., Gardena, Calif.*



**Mention No. 1659 when filling out card.**

### Acid Pump

New motor-driven pump, designed for faster flow of acids and other liquids, elevates flow to a height of 12 feet; is portable, fully equipped with safety air valves which prevent pressure from exceeding 15 psi. Fits all standard carboys.—*General Scientific Equipment Co., 2700 W. Huntingdon St., Philadelphia 32, Pa.*



**Mention No. 1660 when filling out card.**

### Photoelectric Smoke Indicator

New "Series FE Fireye" photoelectric smoke indicator continuously indicates density of smoke passing through stack and signals when density exceeds a preset value. Three basic units: Light Source; Photoelectric Scanner; and Control and Indicator combined in one

YOUR
MONEY BACK
IF IT PLUGS

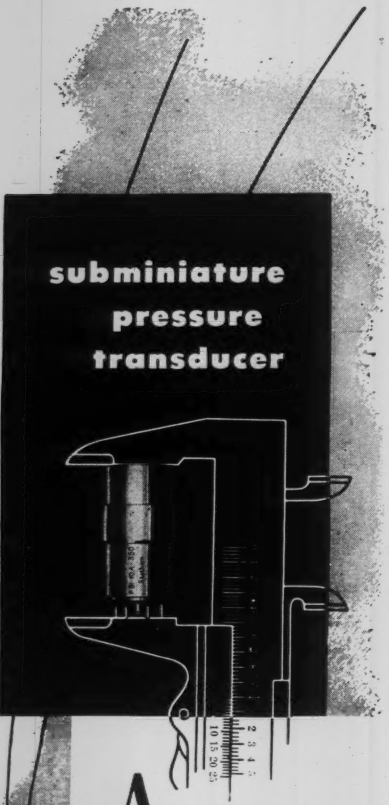
Basically, the Flex-Valve is just a piece of flexible tubing and a clamp to squeeze it shut. It can no more clog than a length of pipe. So, if you can clog one of them in normal service, just tell us, for the "incredible-but-true" record, how in the world you did it, and we'll send your money back.

Flex-Valves have solved thousands of valving headaches —in as many plants as there have been installations made. They can handle anything that flows, including aerated or fluidized solids. They close bubble-tight over 1/8" solids. Open, the flow is straight-in-line with the service piping, and completely unobstructed. There are no moving parts in contact with the lading fluid. Available in both natural and synthetic materials for every corrosive or abrasive service.

*Complete details on this unique principle of control valving in slip-on, flanged, and air-motor operated types are available on request. Ask for* **Bulletin 500**—*without obligation, of course.*

**Farris FLEXIBLE VALVE CORP.**
**610 COMMERCIAL AVE. • PALISADES PARK, N. J.**

1192



A pressure transducer weighing less than 1 ounce provides the accuracy and stability of the familiar unbonded strain gage, unaffected by reduction in size. The design allows flush mounting of the ½ inch diameter diaphragm. Natural frequencies, depending on range, extend to several kilocycles per second, yet the accuracy of ± 1% of full scale holds for static as well as dynamic measurements. The electrical output of the four active arm transducer bridge will operate oscillograph galvanometers directly.

*The Model P81 Subminiature Pressure Transducer is described fully in Bulletin No. 3.4, available upon request.*

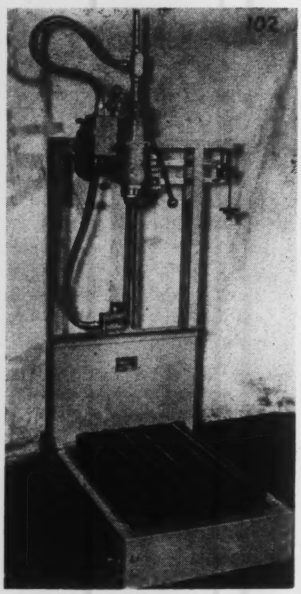
Statham
LABORATORIES
• Los Angeles 64, Calif.

housing. Light source and scanner are mounted on opposite sides of stack or breeching; indicator, placed at any convenient location, shows smoke density reading on 4½-inch scale in both Ringelmann numbers and percent of smoke density. Red and green jewel lights provide visual indications of excessive or efficient smoke conditions.—*Combustion Control Corp.*, 720 *Beacon St., Boston* 15, *Mass.*

**Mention No. 1661 when filling out card.**

## Automatic Drum Filler

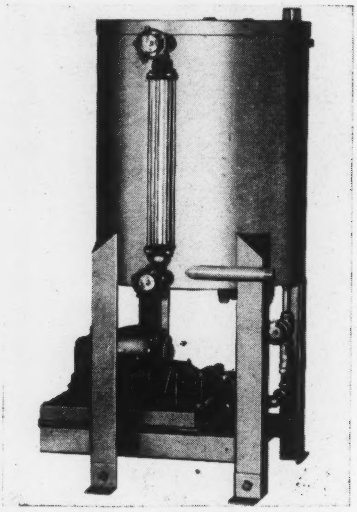
New "Model CEX-1002" drum filler, for filling liquids on the basis of predetermined weight, is electrically operated. Non-drip valve automatically shuts off when container (5 to 55 gal.) is filled to desired weight. 7-in. channel iron frame; outlet valve sizes up to 1-¾ in.: explosion-proof fittings; 17 x 26 in. roller conveyor platform; 1,000-lb. capacity.—*Cass Products Co.*, 27 *Mechanic St., Buffalo, N. Y.*



**Mention No. 1662 when filling out card.**

## Chemical Feed System

New "packaged" chemical feed system, offering considerable savings in installation time and space, consists of a 50-to-500-gal. carbon steel chemical solution tank mounted over maker's "Controlled Volume Pump." Piping is supplied for suction line, complete with valves and liquid level indicator. Accessories including agitators, dissolving baskets, low-level alarm panel, electrodes and relays, etc., can also be supplied.—*Milton Roy Co.*, 1309 *East Mermaid Lane, Philadelphia* 18, *Pa.*



**Mention No. 1663 when filling out card.**

## Universal Gear Train

New universal precision gear-train kit, for servo breadboarding and general laboratory use, features standard ratios from 20:1 to 1250:1, with special ratios up to 15,000:1 available. Ratios are obtained in same basic gear housing by changing gear clusters. Included are 20 gear clusters which provide 19 ratios most commonly used in laboratory.—*Bowmar Instrument Corp., Smith Municipal Airport, Fort Wayne, Ind.*

**Mention No. 1664 when filling out card.**

## Humidity Controller

New "Plug-In" humidity controller is simple automatic humidistat control to operate electrically powered humidifiers and dehumidifiers. Control is hung on wall and dial turned to percentage relative humidity desired. Humidistat is standard human-hair type. Scale extends from 10 to 95 percent relative humidity. Net weight is 2 lbs.—*Abbeon Supply Co., 179-15 Jamaica Ave., Jamaica 32, N. Y.*

ABBEON SUPPLY CO.
179-15 JAMAICA AVENUE
JAMAICA 2, NEW YORK
Humidifiers - Dehumidifiers
203.

**Mention No. 1665 when filling out card.**

## Air-powered Stirrer

New stirrer completely powered by air at 35 to 100 psi., is designed specially for viscous materials: lacquers, paints, oils, synthetics, etc. Speeds from 50 to 1200 rpm. Air motor is rated at 1/6 h.p. at 80 psi. Gear reduction 7:1. Weight 4 lbs. 12-in. shaft and 2.5-in. diameter propeller are stainless steel.—*Arrow Engineering Co., Inc., Hillside, N. J.*

**Mention No. 1666 when filling out card.**

# ELECTRICAL INSTRUMENTS

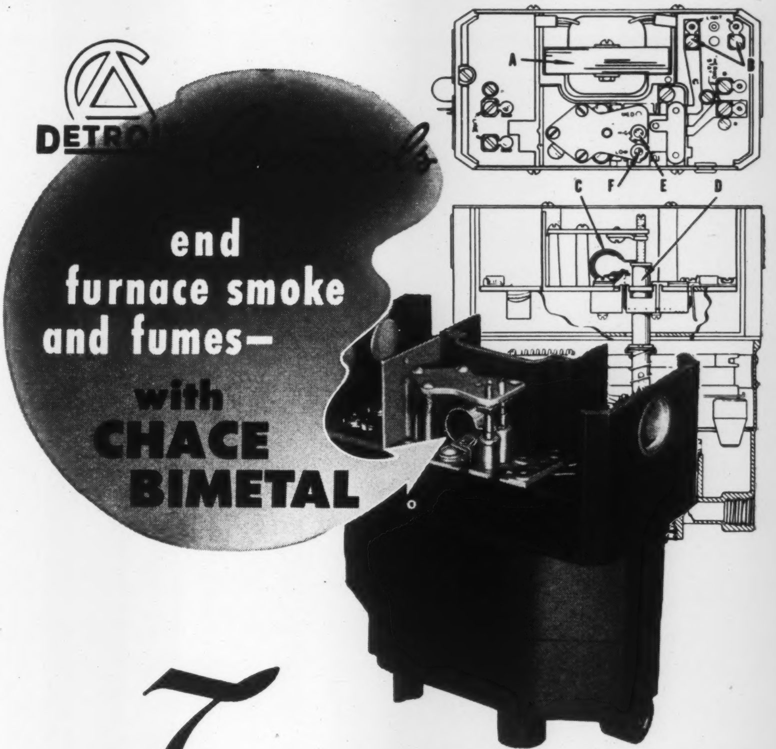
## Microwave Signal Sources

New series of microwave signal sources covers frequency range of 634 to 10,750 Mc. in five units. These employ a reflex klystron as a source of microwave energy. Frequency can be read directly to 10 percent accuracy. A single dial controls cavity frequency and reflector voltage. Modulation inputs for signal sources available on front panel.—*Polarad Electronics Corp., 100 Metropolitan Ave., Brooklyn 11, N. Y.*

**Mention No. 1667 when filling out card.**

## Crystal Test Set

New "Model T104A" crystal test set is a portable self-contained equipment for field testing and selection of 1N23B matched crystal pairs for X-band balanced mixer applications in frequency



Product of Detroit Controls Corporation
Established in 1877 as Detroit Lubricator Company

The CRC-239-F Series Detroit Furnace Controls are electrically operated float valves designed to control the flow of fuel to vaporizing pot type burners in accordance with the demands of an electric wall type thermostat. They incorporate in one compact unit all the mechanism necessary for thermostatically operating the flow control valve and switch mechanism which control the booster fan. This precise regulation of fuel eliminates smoke and carbon formations. The movement of the metering stem which controls the flow of oil to the burner is dependent on Chace Thermostatic Bimetal.

When the thermostat calls for heat it completes the circuit from the 24 volt secondary of the built-in transformer "A" through the limit switch connected to terminals "B" and a heat motor "C". When the heat motor is thus energized it operates the metering stem "D", allowing it to rise to high fire position. This stem moves to low fire position when thermostat opens the circuit. The limits within which the metering stem travels are set by adjusting screws "E", high fire, and "F", low fire.

If the actuating element for your new control device is thermostatic bimetal, Chace has the equipment and qualifications for fabricating it ready for assembly. Our 29 types of bimetal are available in strips, coils, random long lengths and welded or brazed sub-assemblies. We also provide specialized tooling for fabricating to your designs; our application engineers are available for consultation. Write for a copy of our new 32-page booklet, "Successful Applications of Chace Thermostatic Bimetal," containing condensed engineering data.

IT BENDS WITH THE HEAT
**W. M. CHACE CO.**
*Thermostatic Bimetal*
1609 BEARD AVE., DETROIT 9, MICH.

Make a GM
the Heart of Your Instrument

PORTABLE D'ARSONVAL GALVANOMETER

IN THE AUTOMOTIVE FIELD, the Bear Manufacturing Co. of Rock Island, Ill. uses Series 500 G-M Galvanometers in its new remote-reading Electric Wheel Alignment System (left). Whatever your own particular instrument field, you can achieve this same self-contained portability, ruggedness and high sensitivity with G-M Galvanometers. Complete catalog on request.

GM LABORATORIES • INC.
4316 NORTH KNOX AVE., CHICAGO 41
In Canada: Cossor (Canada) Ltd., 301 Windsor Street, Halifax, N. S.

WEBBER LOW-TEMPERATURE TEST CABINET

★ The Webber Low Temperature Test Cabinet illustrated is a standard 9 cubic foot unit with terminal panel added for electrical connection to the inner chamber for testing of electrical equipment. The temperature range is from ambient to −125°F., with a very rapid pull-down time. Temperature can be accurately controlled at any point in the temperature range. Temperature is controlled by a visible type indicating controller with a scale range from −200° to +200°F. Recording temperature controller is available as optional equipment. The freezing chamber will withstand impact loading of 1200 pounds per square foot and uniform distribution static loading of 2,000 pounds per square foot. This prevents damage caused by dropping heavy objects in storage compartment. Available as optional equipment are combination air and water cooled compressors and roller-bearing swivel type casters. There's a Webber Unit for every industrial need.

**Write for new bulletin giving more complete information.**

INDUSTRIAL FREEZER DIVISION
WEBBER APPLIANCE CO., INC.
2740-D MADISON AVENUE • INDIANAPOLIS 3, INDIANA

# NEW INSTRUMENTS

range of 8500-9500 Mc. Provision is made for testing pairs for crystal current balance, IF impedance balance and leakage power (an indication of RF impedance balance). Equipment consists of a 2K25 oscillator, a power-set attenuator, a frequency meter, a directional coupler for determining leakage power test limit, two matched single-ended mixers for measuring leakage power, a balanced test mixer and required power supply and switching circuitry. A VTVM is included for measurement of IF impedance. Suitable switching permits milliammeter and null indicator to serve multiple purposes. Critical circuit constants, however, are independent of switch position.—*Microwave Associates, Inc., 22 Cummington St., Boston 15, Mass.*

**Mention No. 1668 when filling out card.**

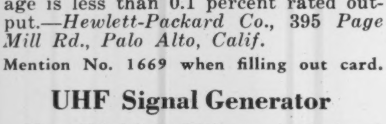
## Wide-range RC Oscillators

New "Models 200AB and 200CD" wide-range RC oscillators of extremely compact size and simple operation are said to have high stability and accurate, quickly-resettable circuits. "Model 200-AB," for general audio tests, offers a frequency range of 20 cps. to 40 kc. and a full watt output. "Model 200CD," for wide-range measurements at lower power levels, provides constant voltage output from 5 cps. to 600 kc. In both, an output amplifier provides complete isolation of load, and changes in output load do not change oscillator performance. Frequency stability is better than 2 percent including warm-up; hum voltage is less than 0.1 percent rated output.—*Hewlett-Packard Co., 395 Page Mill Rd., Palo Alto, Calif.*

**Mention No. 1669 when filling out card.**

## UHF Signal Generator

New "Model 84-TV" standard signal generator, with frequency range of 300 to 1000 Mc., is useful for determining the characteristics of TV receivers and other equipment in UHF band. Output voltage is continuously variable from 0.1 microvolt to 1 volt across a 50-ohm load. Output impedance is 50 ohms and VSWR is 1.3 to 1 or better. Provision is made for operating the filament of the oscillator tube from an external d-c. supply to remove residual hum. Modulation, continuously variable from 0 to 30 percent, may be obtained from an internal 400-cps. oscillator. Provision is also made for applying external modulation within range of 50 to 20,000 cps.—*Measurements Corp., Boonton, N. J.*



**Mention No. 1670 when filling out card.**

## TV Monitor

New "Model M-104C Studio Picture Monitor" comprises a 12-in. prelined screen kinescope removable from front; is self-contained; presents a TV picture of black-and-white or color signals in black-and-white at turn of switch. Input signal 1 volt peak-to-peak; input impedance 470,000 ohms; resolution in excess of 450 lines.—*Polarad Electronics Corp., 100 Metropolitan Ave., Brooklyn 11, N. Y.*

**Mention No. 1671 when filling out card.**

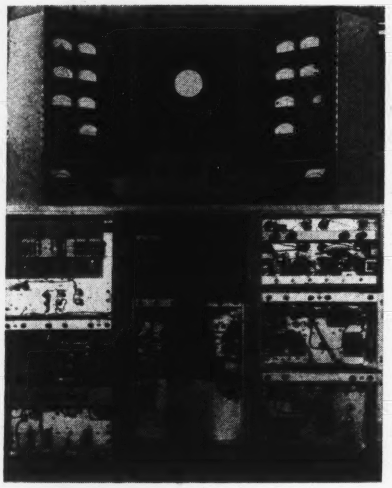
## Tape Recorder

New "Broadcaster Model 610-SD," battery-powered portable tape recorder with spring-wound motor, offers performance ratings in complete accordance with NAB specs. Flashlight type dry cell batteries last 100 operating hours without replacement. Constant tape speed, with flutter content within 1 percent, over full winding cycle of six minutes. Triple-purpose indicator light signals 30 seconds before rewinding is necessary, shows if switch is accidently left on, and instantly indicates any variation in tape speed. Tape speed, 7.5 in. per sec., 15 minutes on standard 600-ft. reel of sound recording tape. Single-track record head with double-gap (for double life) is used. Recordings can be made while instrument is being carried. Earphone monitoring while recording is possible, as well as immediate playback either through earphones, or into an auxiliary amplifier or speaker, or into telephone transmision lines.—*Magnemite Div., Amplifier Corp. of America,* 398 *Broadway, New York* 13, *N. Y.*

**Mention No. 1672 when filling out card.**

## Cathode-ray Tube Analyzer

New "Type 2166" console unit for production testing of electrostatic cathode-ray tubes has plug-in adapter for each type or series of tubes and linear sweep system with amplitudes sufficient for any tubes of today or future. Housed in metal cabinet 60 x 75 x 36 inches with lighted desk space.—*Allen B. Du Mont Laboratories, Inc.,* 1500 *Main Ave., Clifton, N. J.*



**Mention No. 1673 when filling out card.**

## Cathode-ray Tube Analyzer

New "Model 707 Dynamic Cathode Ray Tube Analyzer" tests all TV picture tubes (magnetic and electrostatic deflection types) also analyzes oscilloscope, radar, and other special-purpose CR tubes without removal from chassis or carton. Four classes of tests are made with new analyzer. (1) Beam current test is made to final anode; beam current scale also forecasts remaining tube life. (2) Grid test, to observe grid control over beam current.

AEMCO

RELAYS

you can rely on!

A manufacturer's reputation and that of his products are often determined by the performance of relays. Little wonder that more and more design engineers and manufacturers are specifying the "Diamond Seal for Diamond Quality" . . . Automatic Electric Manufacturing Company's Relays.

Unexcelled high standards of material and craftsmanship combine to produce superior relays that are built to exceed—not just meet—the most exacting specifications. Automatic Relays are available in a wide variety of spring and coil combinations . . . operating potentials and contact ratings for an almost limitless variety of applications.

OPEN AND SEALED TYPE RELAYS

Whether your requirements demand plug-in tube base or any of the other standard type mountings,—or a specialized mounting—it will pay you to get complete facts on Automatic Relays with *built -in reliability!* Automatic midgets, dual purpose, delayed make or break, circuit control, current and potential Relays are built to exceed specs, *military or industrial.* If you measure quality by performance, Automatic Relays will measure up!

AEMCO

**The complete line of Automatic Relays are available to meet military specifications. The facilities of our engineering department are at your disposal. Write, wire or phone. All inquiries will receive prompt attention.**

*Automatic Electric* MFG. CO.

58 STATE STREET · MANKATO, MINN.

Fine
PRESSURE
GAGES . . .

—are the result of good design, careful selection of materials and meticulous care in manufacturing.

In the Acragage you get these three vital factors plus the famous solid front with full area blow out disc.

Catalog M-50 tells much about these better Acragages.

Send for your copy today.

The ACRAGAGE
Corporation
WAMPUS LANE • MILFORD, CONN.

ELECTRONICALLY REGULATED
LABORATORY
POWER SUPPLIES

RACK MODEL 32

• STABLE • DEPENDABLE • MODERATELY PRICED •

STANDARD RACK MOUNTING PANEL SIZE 10½" x 19" DEPTH 9" WEIGHT 35 LBS

- INPUT: 105 to 125 VAC, 50-60 cy
- OUTPUT #1: 200 to 325 VDC at 300 ma regulated
- OUTPUT #2: 6.3 Volts AC CT at 5A unregulated
- OUTPUT #3: 6.3 Volts AC CT at 5A unregulated
- RIPPLE OUTPUT: Less than 10 millivolts rms

For complete information write for Bulletin N-2X

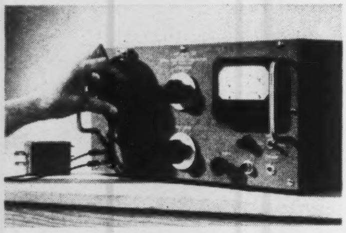
LAMBDA ELECTRONICS
CORPORATION
CORONA NEW YORK

(3) Gas test indicates whether or not gas is sufficient to threaten quick failure of screen or cathode or both. (4) All elements are isolated for individual inter-element leakage tests. Flexibility insures against obsolescence as new CR tubes are developed.—*The Jackson Electrical Instrument Co., 20-30 S. Patterson Blvd., Dayton 2, Ohio.*

**Mention No. 1674 when filling out card.**

## Wave Analyzer

New "Model 121" wave analyzer for frequencies of 15 to 500 kc. analyzes frequencies and amplitudes of signal components in a complex wave form.

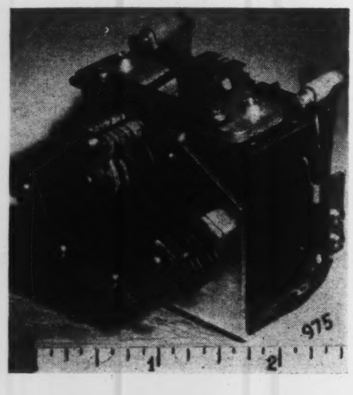


Novel two-attenuator design permits wide range of measuring amplitudes without introduction of instrument distortion. Signal components are read directly on 4-in. indicator calibrated in db. Voltage calibration is accomplished with internal 100-kc. injection oscillator; listening jack is provided for monitoring signal being measured. Applications are for characteristics of filters, level studies, etc. Input level range is from plus 42 dbm. to minus 70 dbm. at 600-ohm impedance level. Selectivity is such that response is 3 db. down at 100 cps. off resonance. Weight is 35 lbs.—*Sierra Electronic Corp., 831 Brittan Ave., San Carlos, Calif.*

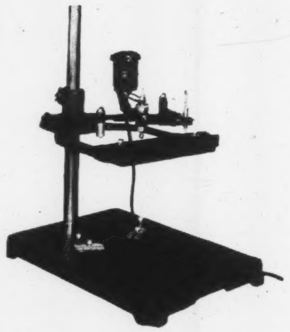
**Mention No. 1675 when filling out card.**

## Stepping Switch

New "Model 27000 Bi-Directional Stepping Switch" is capable of advancing or reversing with equal ease and speed, hence adaptable to applications impracticable for conventional switches. As a differential counter it can be used to indicate a remaining quantity, as in a hopper, continuous oven, can fillers, etc., where each unit



MICO
ENGRAVER



A further adaptation of the already proven Mico Engraver. Will perform accurate engraving on panels 19-inches wide and of unlimited length. Accommodates work up to 19-inches high.

Catalog on request

MICO INSTRUMENT CO.
86A Trowbridge Street
Cambridge 38, Mass.

2500 P.S.I.

MERCOID
DA PRESSURE CONTROLS
PROVIDE THE SENSITIVITY
YOUR APPLICATION REQUIRES

MERCOID
SWITCH

Available in pressure ranges varying from 30" vacuum to 2,500 p.s.i.

- FULLY ADJUSTABLE AS TO RANGE AND SENSITIVITY
- BOURDON TUBE OPERATED
- VISIBLE CALIBRATED DIAL
- MERCOID SEALED MERCURY CONTACT

30" VAC.

CATALOG SENT UPON REQUEST

THE MERCOID CORPORATION
4201 BELMONT AVE., CHICAGO 41, ILLINOIS

inserted advances switch and each outgoing unit reverses it one step. As a remote positioning motor it can be commanded by bidirectional remote dials or shafts having stops at discrete points. In automatic computers it can be used as a digit-storage register, a single switch being able to add or subtract over separate control paths. As an automatic attenuator it adds or subtracts (through its unique reversibility) resistances for adjusting gain and preventing overloads. As a digital self-balancing bridge, new switch, together with discrete resistance steps, converts analog test or process data directly to digital contact closures immediately available for computation or control. Electromagnet-operated pawl-and-ratchet mechanism steps output shaft to 36 discrete angular positions in 10-degree steps. Drive is direct, not through use of springs. A typical switch has four parallel circuits to 12 positions. (Specials can be furnished.) An interlock positively prevents partial steps due to a defective control pulse or signal; and wipers cannot be positioned between steps. Driving mechanism is easily separated from contact bank for servicing or for use as a stepping motor without affecting adjustment or mounting.—*Consolidated Engineering Corp., Pasadena* 8, *Calif.*

**Mention No. 1676 when filling out card.**

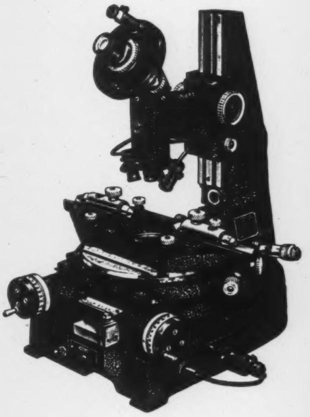
## ULF Oscillator

New "Model 400-C" ultra-low-frequency oscillator is R-C bridge oscillator that simultaneously provides both sine and square-wave voltages at any frequency between 0.009 and 1,100 cps. Sine-wave output may be used either balanced or single ended. Maximum output is 30 volts peak to peak across 1,000-ohm load. Features are no tuning and band-switching transients, low hum and distortion, excellent amplitude constancy over frequency range, single-scale logarithmic dial with a vernier tuning control, and low input power. Dimensions are 19 x 8¾ x 7½ inches. —*Krohn-Hite Instrument Co.,* 580 *Massachusetts Ave., Cambridge* 39, *Mass.*

**Mention No. 1677 when filling out card.**

## Wide-band Microwave Receivers

New series of four wide-band microwave receivers cover frequency range from 1000 to 10,750 Mc. Triple-tuned r.f. preselection insures high image rejection. High order of gain stability permits application as a field intensity meter. Frequency stability permits accuracy of reading of better than 2 percent. Among features: linear db indication, single-dial tuning, low noise



***The Gaertner***
**TOOLMAKERS' MICROSCOPE**

***For use wherever precision measurements are required in shop inspection or layout procedures.***

INCH OR METRIC UNITS
Coordinate Measurements
Left to Right.......100 mm or 4 inches
Front to Rear ...... 50 mm or 2 inches
Direct Reading to..0.002 mm or 0.0001 inch
Angular Measurements
Stage Range.................. 360°
Reading with Vernier.......... 1 min.
Protractor Circle Range........ 360°
Reading with Vernier.......... 1 min.
Magnification .................. 30X
Microscope Column Tilt.......... ±8°

- **Detects errors in cutting tools.**
- **Checks threads and thread gages.**
- **Measures critical dimensions on machine and instrument parts.**
- **Adaptable to flat work, round work, odd shapes.**

A completely illustrated booklet presenting detailed information on all models and accessories and suggesting applications.

*REQUEST BULLETIN* 147-50

**THE GAERTNER SCIENTIFIC CORP.**
**1211 WRIGHTWOOD AVE., CHICAGO 14, ILL.**

**TANK-O-METER**
FOR MEASURING TANK
CONTENTS ANY DISTANCE AWAY

ANY LIQUID

**HYDROSTATIC GAUGES**
FOR ALL PURPOSES

PRESSURE • VACUUM • DRAFT
DEPTH & ABSOLUTE PRESSURE
BAROMETRIC PRESSURE
DIFFERENTIAL PRESSURE
*SEND FOR BULLETINS*

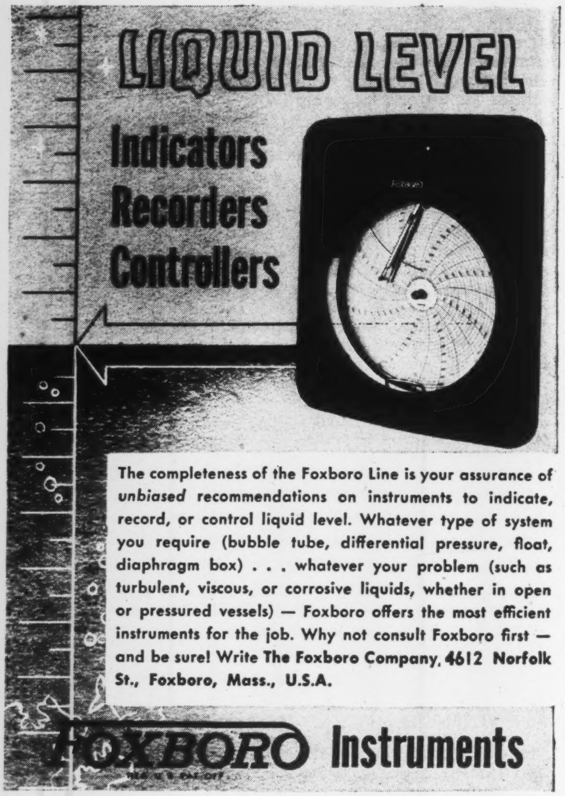
**UEHLING INSTRUMENT CO.** 470 GETTY AVE., PATERSON, N. J.

**DAVEN has Built a Great REPUTATION**

**on SWITCHES like this...**

. . . and hundreds of other standard units . . . available for quick delivery. DAVEN can also effect quick changes from standard units to special switches by using components at hand. That's why when you specify DAVEN you are assured of immediate attention to your needs. Write for more detailed data.

THE DAVEN CO.
175 Central Ave.
Newark 4, N. J.


**LIQUID LEVEL**

**Indicators**
**Recorders**
**Controllers**

The completeness of the Foxboro Line is your assurance of *unbiased* recommendations on instruments to indicate, record, or control liquid level. Whatever type of system you require (bubble tube, differential pressure, float, diaphragm box) . . . whatever your problem (such as turbulent, viscous, or corrosive liquids, whether in open or pressured vessels) — Foxboro offers the most efficient instruments for the job. Why not consult Foxboro first — and be sure! Write The Foxboro Company, 4612 Norfolk St., Foxboro, Mass., U.S.A.

FOXBORO Instruments

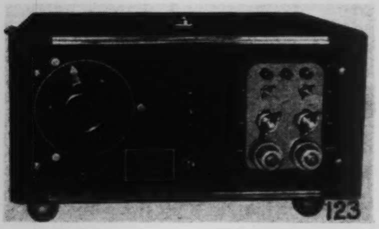
## NEW INSTRUMENTS

figure, AM-FM reception, and AFC. Video bandwidth is such that a 1-microsecond undistorted pulse of 10 volts will appear across an output impedance of 100 ohms. Individual ranges: 1000-2100, 2000-4500, 4400-8400, and 7000-10,750 Mc.—*Polarad Electronics Corp., 100 Metropolitan Ave., Brooklyn, N. Y.*

**Mention No. 1678 when filling out card.**

### High-current Test Unit

New "Model 1005 Portable High Current Test Unit," designed primarily for use by electrical utilities and larger industrials, has output adjustable in



stepless increments from 0 to 1000 amperes in eight ranges, each range rated at 2.5 kva based on a four-hour duty cycle. Terminal voltages are adjustable from 0 to 115 percent of 200, 100, 75, 50, 25, 10, 5, and 2.5 volts. Perfect waveform is maintained within output rating.—*Multi-Amp Corp., Harrison, N. J.*

**Mention No. 1679 when filling out card.**

### C-r. Oscilloscope

New "Type 304-A Oscillograph," for qualitative analysis and quantitative measurements, features a built-in calibration system which permits voltage measurements directly from cathode-ray screen. Maximum sensitivity of zero point is one p.-p. volt full scale, on 4-in. scale. To measure a potential, a square-wave voltage-standard is placed on screen. Calibrated screen reading is multiplied by setting of MULTIPLIER knob, thus giving voltage of input signal. "Type 5ADP" tube provides brilliant trace. Illuminated calibrated scale is marked in fifth-inches; rheostat allows variable intensity of scale lighting. —*Allen B. Du Mont Laboratories, Inc., Clifton, N. J.*

**Mention No. 1680 when filling out card.**

## POWER SUPPLIES

### Regulated Power Supplies

New "Model 400" regulated power supplies are for multiple-output systems with both filament and d-c. voltages controllable at a central point. Features include relay control of plate and filament voltage and compact physical size. "Model 401" has output of 250 to 500 v. d.c., 650 v. d.c. at 200 ma. unregulated, and 6.3 v. a.c. at 6 amp. unregulated. "Model 402" has 150 to 325 v. d.c. at 200 ma., 450 v. d.c. at 200 ma. unregulated, and 6.3 v. d.c. at 6 amp. unregulated. Regulation is within ½ percent for load variations of zero to 200 ma. and line variations of 105-125 v. a.c. Ripple is 5 mv. or less. —*Bristol Engineering Corp., Lincoln Ave. & Pond St., Bristol, Penna.*

**Mention No. 1681 when filling out card.**

### Regulated Power Supply

New "Model E-300-1" B supply was designed originally for a test position requiring 300 volts d.c., regulated, at 1 ampere. Regulation 1 percent for line

and load changes from zero to full load; ripple, 10 mv.—*Sorensen & Co., Inc., 375 Fairfield Ave., Stamford, Conn.*

**Mention No. 1682 when filling out card.**

### High-frequency Power Supply

New "Model AEC-1030" electronic regulated power supply is designed to produce a regulated 115 v. ac. output at frequencies other than 60 cps. Range is 36-40 kc., others available on re-

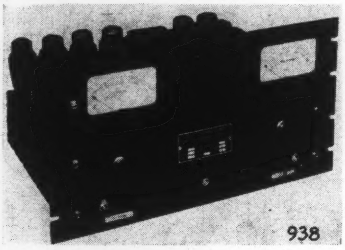
**See pages 1766-1767 for classified list of advertised products.**

quest. Frequency calibration and stability better than 2 percent under normal temperature conditions. Regulation from 0 to 3-amp. load is 5 percent. Set operates from 115-v. ac. 50-60-cps. line.—*American Electroneering Corp., 5025 W. Jefferson Blvd., Los Angeles, Calif.*

**Mention No. 1683 when filling out card.**

### Regulated Power Supply

New "Model No. M-900" regulated d-c. power supply has output of 300 volts, regulated to within 0.15 percent at any current load from 0 to 500 milliamperes. Inherent ripple is below 0.004 rms volts. A time delay relay withholds output for 40 seconds after initial energization for thermal stabilization and protection of circuits powered by the supply, during their warm-up period. A regulated d-c. bias output of minus 105 volts is also provided.—*Perkin Engineering Corp., 345 Kansas St., El Segundo, Calif.*

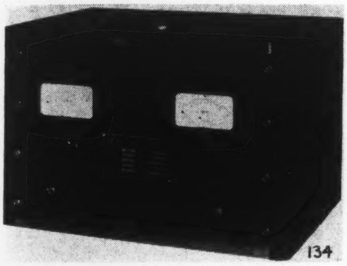


938

**Mention No. 1684 when filling out card.**

### Regulated Rectifier

New "MagniVolt" is said to be a new type of high-performance ac. to dc. regulated rectifier. Regulation is better than 1 percent from no load to full load with plus or minus 10 percent ac. line variation. Response is faster than 0.2 second, even under extreme contrast of load conditions. Ripple is less than 1 percent. Standard models from 1.2 to 28.0 volts, and from 2.5 to 30.0 amperes. Makers claim that superiority is largely due to specially-developed magnetic amplifier which contains no moving parts or vacuum tubes.—*INET, Inc., 8655 South Main Street, Los Angeles 3, Calif.*



134

**Mention No. 1685 when filling out card.**

### Stepdown Transformers

New stepdown transformers permit motors, refrigerators, lighting fixtures, as well as electrical machinery and equipment made for operation on 110

LICK SOLDERING FATIGUE!

—with the new HEXACON FEATHERWEIGHT MODEL 30H

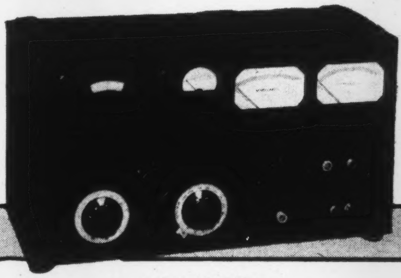
So light its weight is hardly noticeable, but more powerful than its wattage rating indicates. Hatchet design makes it more comfortable and practical to use than a soldering pencil. No transformer required.

WEIGHT—5½ OUNCES (LESS CORD); WATTS—40 OR 60; TIP DIA.—BOTH ⅛" AND ¼" TIPS FURNISHED WITH EACH IRON; PRICE— $5.50

Write today for catalog describing the complete line of screw tip, plug tip and hatchet irons.

HEXACON ELECTRIC CO.
179 WEST CLAY AVE.,
ROSELLE PARK, N. J.

HEXACON



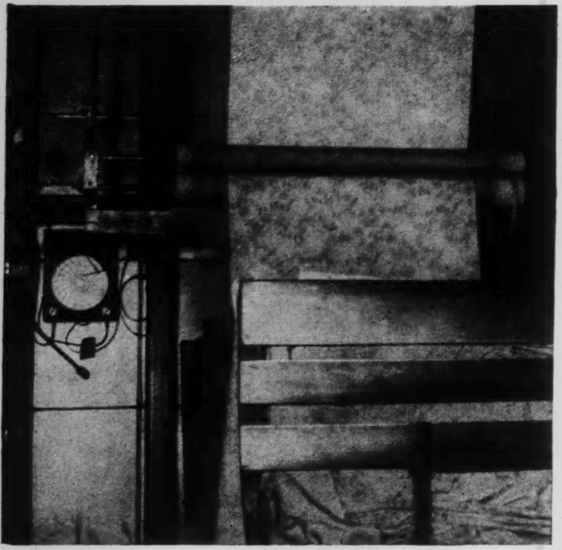
NEW! UHF TELEVISION Standard Signal Generator

MODEL 84-TV
300—1000Mc.

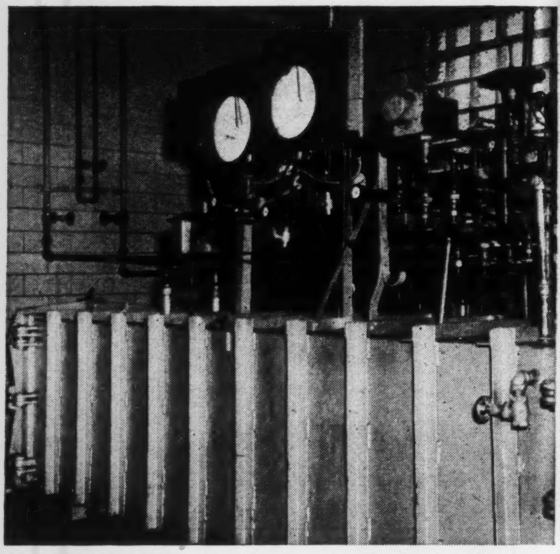
SPECIFICATIONS
FREQUENCY RANGE: 300-1000 megacycles.
OUTPUT: .1 Microvolt to 1 Volt, across 50 Ohms.
OUTPUT IMPEDANCE: 50 Ohms coaxial.
MODULATION: Internal 400 cycle, continuously variable from 0 to 30%. Provision for external modulation of 50 to 20,000 cycles.
LEAKAGE: Negligible.
SIZE: Overall Dimensions: 11¾ inches high, 19 inches wide, 11 inches deep.
WEIGHT: Approximately 40 pounds.
POWER: 115 volts, 60 cycles, 120 watts.
Write for complete details

MANUFACTURERS OF
Standard Signal Generators
Pulse Generators
FM Signal Generators
Square Wave Generators
TV Standard Signal Generators
Vacuum Tube Voltmeters
UHF Radio Noise & Field Strength Meters
Megacycle Meters
Intermodulation Meters
TV & FM Test Equipment

MEASUREMENTS CORPORATION
BOONTON NEW JERSEY



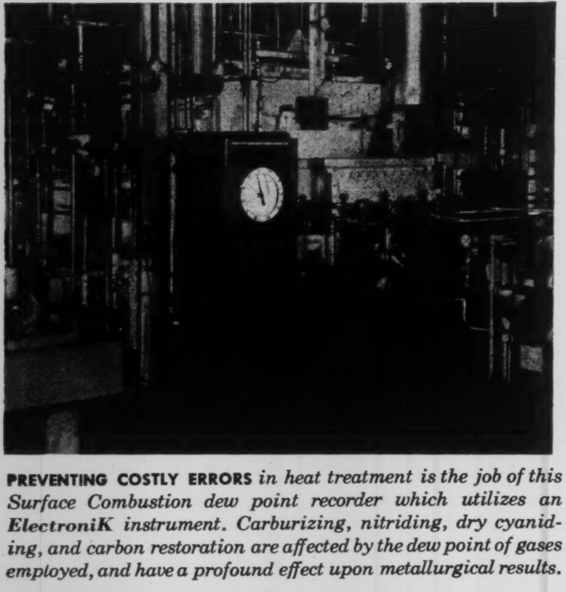
**$30,000 SAVING IN ONE YEAR** *was effected in this textile finishing mill . . . with the help of the Brown thermometer controlling the temperature of the print dryer. Controlled condition drying eliminated jagged fabric rips which had resulted in absolute waste.*



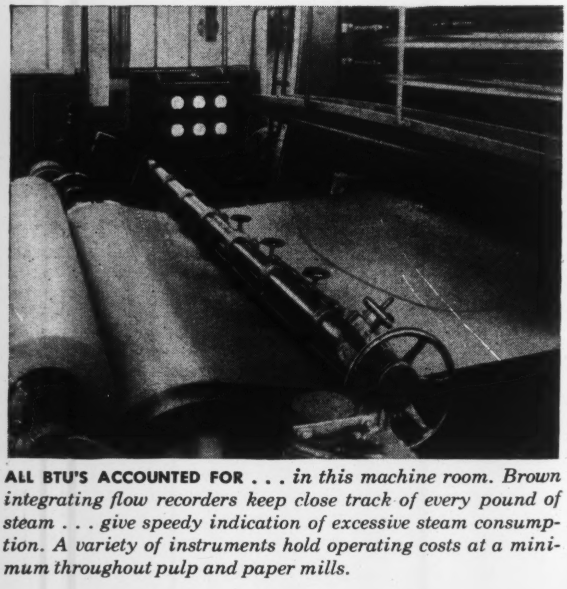
**DUAL USE OF RETORT,** *thanks to custom-built control system, permits using same equipment for boiling meats that is used for pressure-cooking glass-packed products. Cook time has been cut; glass breakage eliminated; labor saved; and production increased for both jobs.*

# From lab . . . to pilot plant . . .

# *Instruments*



**PREVENTING COSTLY ERRORS** *in heat treatment is the job of this Surface Combustion dew point recorder which utilizes an ElectroniK instrument. Carburizing, nitriding, dry cyaniding, and carbon restoration are affected by the dew point of gases employed, and have a profound effect upon metallurgical results.*



**ALL BTU'S ACCOUNTED FOR . . .** *in this machine room. Brown integrating flow recorders keep close track of every pound of steam . . . give speedy indication of excessive steam consumption. A variety of instruments hold operating costs at a minimum throughout pulp and paper mills.*

tem,
used
has
duc-

n
of

---

**BLEACHING COSTS SLASHED** . . . *by carefully engineered control system that guards against waste of steam, stock and chemicals in this modern, one-man peroxide bleach plant.*

# to process operation

# *reduce costs*

MODERN METHODS of measurement and control—with Brown instruments—are proving to be potent weapons in the battle against soaring production costs. In literally hundreds of plants, these instruments are helping to slash major cost items . . . in these ways:

***Reducing labor costs***—through more effective utilization of manpower . . . centralization of process data from simplified supervision . . . assuming countless routine and time-consuming burdens.

***Reducing materials costs***—through elimination of rejects . . . recovery of process chemicals . . . precise allocation of exactly the right amount of fuel, reagent, steam or other materials to attain specified results.

***Improving production efficiency***—through reduction of process down-time . . . elimination of re-running . . . longer on-stream periods . . . higher production speeds.

Add up all these and you'll appreciate why research and production men report that Brown instruments often pay for themselves in a surprisingly short time. Our local engineering representative will be glad to discuss how Brown instruments can cut your own plant's operating costs. Call him today, he is as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4482 Wayne Ave., Philadelphia 44, Pa. Service facilities available in more than 55 cities in the United States.

MINNEAPOLIS
**Honeywell**
BROWN INSTRUMENTS
*First in Controls*

H
HONEYWELL

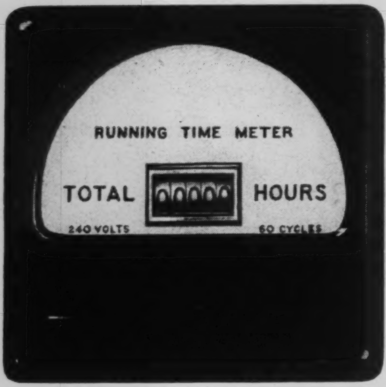
● ***Important Reference Data***

**Write for copy of new brochure, "Tomorrow is Today". . . and request Data Sheets on specific processing operations of interest to you.**

- **DESIGNED**
- **ENGINEERED**
- **MANUFACTURED for PRECISION PERFORMANCE**

**Burlington**

**RUNNING TIME METER**



- **9999.9 hour range**
- **10,000 hour automatic reset**
- **—55 to +55° C. operating temperature.**

- Designed for use on AC lines where successful servicing of electronic or electrical equipment depends upon the regular servicing of such equipment based on actual operating (or idle) time. Unit has a range of 9999.9 hours and resets automatically at 10,000 hours. Can be supplied for either 120 or 240 volts. 60 cycle operation and has operating temperature of —55 to +55° C.

- The Running Time Meter is housed in Burlington's attractive, black bakelite 3" square or 3½" round case.

Write Dept. H-122 for further details.

**BURLINGTON INSTRUMENT COMPANY**
**BURLINGTON, IOWA**

Portable Model I-S
TRACER-GUIDED FOR UNSKILLED LABOR

**ENGRAVE**

PANELS OF ANY DIMENSIONS IN YOUR OWN SHOP

with the Engravograph

The *only* portable machine which reproduces 15 sizes from one master alphabet.

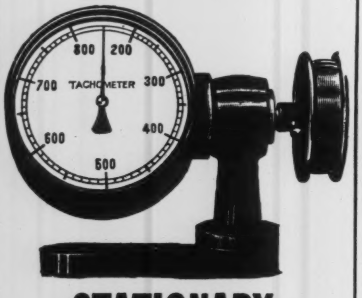
The *only* one with *adjustable* copy holding slides for multiline engraving in one set-up.

Self-centering holding vise for nameplates

**Send for Booklets**
**I-S-37—portable model • H-37—heavy duty model**

**NEW HERMES, Inc.**
13-19 University Place, N.Y. 3, N.Y.
CANADA: 359 St. James St., Montreal

**Amthor**



**STATIONARY TACHOMETERS**

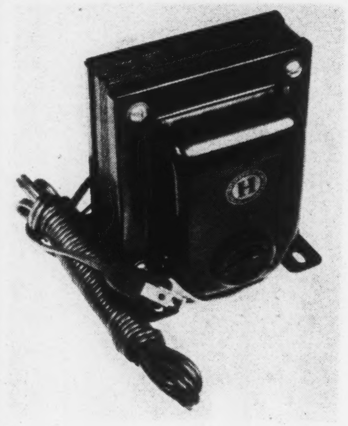
**CENTRIFUGAL TYPE**

Indicating R.P.M., F.P.M., etc.
Belt, Sprocket, or Flexible
Shaft Drives

***Models available for practically every requirement.***

Immediate and intelligent attention will be given to your inquiries on all industrial speed measurement problems. Drop us a line today.

**Amthor Testing Instrument Co., Inc.**
**49a Van Sinderen Ave. Brooklyn, N. Y.**



to 120 volt, 50/60 cycle line to function properly from a 220 to 240 volt, 50/60 cycle supply. New line will be made in several different types. Mounted outside of equipment is "Type ET" (illustrated) with a 6-foot cord and plug for input, and standard receptacle in end shell for output. "Type BT," mounted as part of equipment or appliance, is supplied with flex leads for input and output. "Type SS" completely enclosed for high humidity or corrosive atmosphere.—*Hindle Transformer Co., Flemington, N. J.*

**Mention No. 1686 when filling out card.**

### D-c. Power Supplies

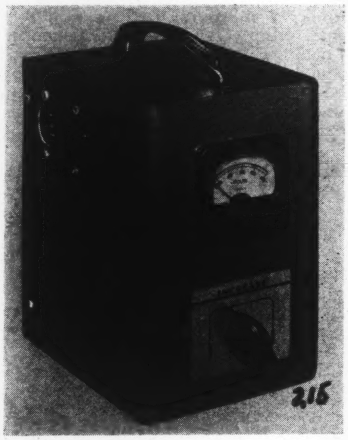
New line of selenium rectifier power supplies, designed for installation at individual work stations, comprises a 300-watt unit and a 500-watt unit, operating from 115-volt 60-cycle line, and furnishing from 90 to 135 volts of filtered d-c. output. Output voltage may be varied in approximately equal steps by a 5-position tap switch. Both units are rated for continuous duty at full load. Overload protection is built into circuit.—*Rapid Electric Co., 2881 Middletown Road, New York 61, N. Y.*

**Mention No. 1687 when filling out card.**

**See pages 1766-1767 for classified list of advertised products**

## Line-voltage Booster

New "V-15" booster provides full 110-volt output (500 to 1500 watts) where line voltage is low. Voltmeter indicates line voltage and load voltage—switch increases output 5 volts per step. Can raise 85 volts to 120 volts with 1250-watt load. Weight is 10 pounds.—*Radio Apparatus Corp.*, 55 *N. New Jersey St., Indianapolis* 4, *Ind.*



**Mention No. 1688 when filling out card.**

## Regulated Power Supply

New "Model No. 33HRR" 1 kv. to 30 kv. regulated, reversible, 5 milliampere rating, RF d-c. power supply has been developed to provide a tool for serious research beyond usual current limitations of such power supplies. Up to 400 watts of regulated a.c. may be drawn from front-panel outlets while up to 5 kv. at 5 ma. is supplied. Regulation 0.1 percent at all voltages. Numerous safety features.—*Neutronic Associates*, 83-56 *Vietor Ave., Elmhurst* 73, *N. Y.*

**Mention No. 1689 when filling out card.**

## Regulated Power Supply

New "Model 141" comprises one regulated B supply and one unregulated filament supply. B supply is continuously variable from 100-400 volts and delivers from 0-150 ma. In range 100-400

WHERE YOU CAN BUY

Rochester DIAL THERMOMETERS

For added pressure and corrosion resistance, ROCHESTER bi-metallic thermometers are stainless steel welded at case, stem and plug. Available with handy recalibration feature. Order from your nearest ROCHESTER Representative listed below:

**BALTIMORE 18, MD.**
Energy Control Co.
2127 Maryland Ave.

**BOSTON, MASS.**
G. K. Kerisher
108 E. Dedham St.

**CHARLOTTE 1, N. C.**
Mec-Tric Control Co.
113 South Brevard St.

**CHICAGO 20, ILL.**
Rochester Mfg. Co.
9443 South Ashland Ave.

**CLEVELAND 13, OHIO**
Ralph M. Nelson
712 Marshall Bldg.

**CORPUS CHRISTI, TEXAS**
Brance-Krachy Co.
118 North Staples

**DETROIT 2, MICH.**
Metrol Co.
5538 Cass Ave.

**HOUSTON, TEXAS**
Brance-Krachy Co.
P. O. Box 1724

**KALAMAZOO, MICH.**
Metrol Co.
420 W. South St.

**KANSAS CITY 6, MO.**
Snyder & Co.
903 McGee St.

**LOS ANGELES 14, CALIF.**
G. R. Schumann Co.
712 S. Olive St.

**NEWARK 2, N. J.**
Energy Control Co.
868 Broad St.

**NEW HAVEN, CONN.**
Energy Control Co.
31 State St.

**NEW YORK 7, N. Y.**
Energy Control Co.
5 Beekman St.

**ODESSA, TEXAS**
Industrial Instrument Corp.
P. O. Box 1909

**PHILADELPHIA 3, PA.**
Devic Engineering
1701 Walnut St.

**PORTLAND, OREGON**
G. R. Schumann Co.
Terminal Sales Bldg.

**SAN ANTONIO, TEXAS**
Brance-Krachy Co.
434 Transit Tower Bldg.

**SAN FRANCISCO 3, CALIF.**
G. R. Schumann Co.
1355 Market St.

**SHREVEPORT 88, LA.**
Paul E. Rogers
P. O. Box 967
266 Patton Ave.

**ST. LOUIS 3, MO.**
MacGregor-Sears Co.
108 North 18th St.

**SYRACUSE 6, N. Y.**
George O. Miller
441 Ridgewood Drive

**TULSA 10, OKLA.**
Snyder & Co.
1432 East 6th St.

**WICHITA, KANSAS**
Snyder & Co.
P. O. Box 2836
South Wichita Station

**IN CANADA**

**TORONTO, ONT.**
Baker Instruments Ltd.
185 Davenport Road

**VANCOUVER, B. C.**
Baker Instruments Ltd.
666 Alexander St.

ROCHESTER Dial Thermometers are a product of ROCHESTER MANUFACTURING COMPANY, INC., Rockwood Street, Rochester 10, New York

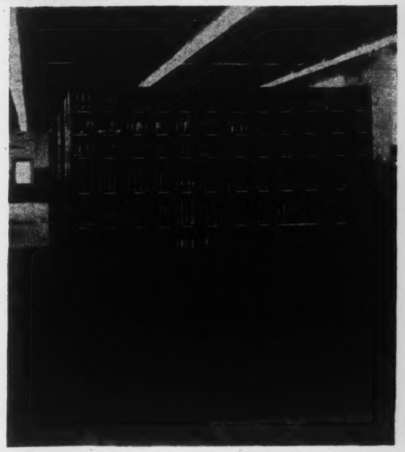
AVAILABLE

NOW!

from Stock

TRINITY

THERMOWELLS



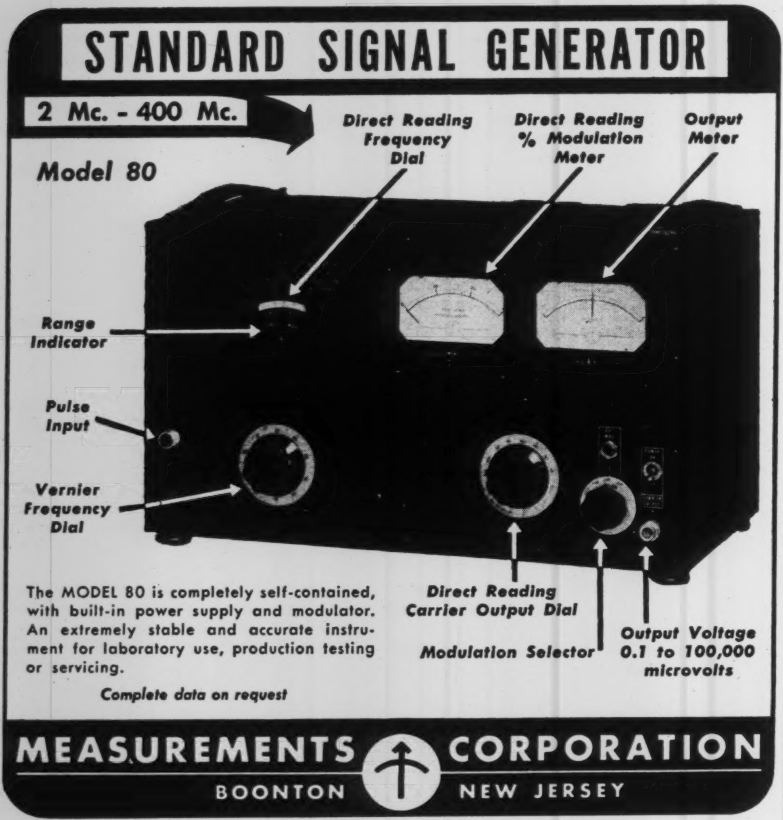
—in a wide variety of designs, sizes and materials.

We will be glad to place your name on the list to receive copies of the monthly Trinity Thermowell Stock List.

• Request your copy now. •

2106

TRINITY EQUIPMENT CORPORATION
494 Westfield Ave., East
Roselle Park, New Jersey
THERMOWELLS and other Specialties for the Process Industries



STANDARD SIGNAL GENERATOR

2 Mc. - 400 Mc.

Model 80

Direct Reading Frequency Dial
Direct Reading % Modulation Meter
Output Meter
Range Indicator
Pulse Input
Vernier Frequency Dial
Direct Reading Carrier Output Dial
Modulation Selector
Output Voltage 0.1 to 100,000 microvolts

The MODEL 80 is completely self-contained, with built-in power supply and modulator. An extremely stable and accurate instrument for laboratory use, production testing or servicing.

Complete data on request

MEASUREMENTS CORPORATION
BOONTON NEW JERSEY

Over 85% of the torque wrenches used in industry are

Sturtevant
TORQUE WRENCHES
Read by Sight, Sound or Feel.

- Permanently Accurate
- Practically Indestructible
- Faster—Easier to use
- Automatic Release
- All Capacities

*in inch ounces . . . inch pounds . . . foot pounds (All Sizes from 0-6000 ft. lbs.)*

STURTEVANT TORQUE MANUAL

Every manufacturer, design and production man should have this valuable data. Sent upon request.

ACROMARK

MACHINES for NUMBERING and MARKING

"The most complete line of machines and tools for marking in America."

Equipment for marking and stamping, embossing, printing and stenciling methods. Steel type, stamps, numbering and marking machines carried in stock.

Model HN Numbering Machines (hand style)—all numbers on each wheel.

HERCULES HOLDERS and Shoulder Style Steel Type for numbering.

ACROMARKER Name Plate Stamping Machines are made in several models and sizes for hand and foot operation.

Write for latest literature and prices

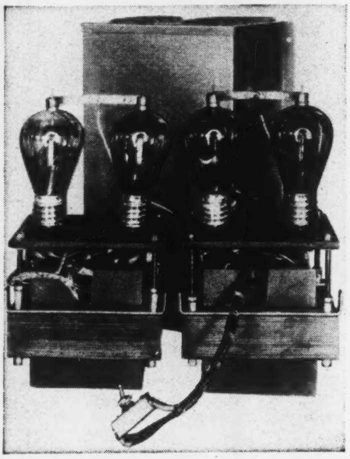
The ACROMARK Company
3-11 MORRELL ST.
ELIZABETH 4, NEW JERSEY
"The Original Marking Specialists"

volts, output voltage variation is less than 0.5 percent for both line fluctuations from 105-125 volts and load variations of minimum to maximum currents. Ripple is less than 5 mv. peak-to-peak. Filament supply is 6.3 volts, 10 amps, unregulated, center tapped and ungrounded. Unit is designed for relay rack mounting or bench use.—*Kepco Laboratories, Inc., 131-38 Sanford Ave., Flushing, N. Y.*

**Mention No. 1690 when filling out card.**

### Dual-channel Rectifier

New dual-channel rectifier is practically two rectifiers housed in one 15 x 5.5 x 16.75-in. sheet steel cabinet; operates on any a-c. input, yielding 2 to 15 amps, 110 or 220 volts.—*Electronic Rectifier Co., Rochester, N. Y.*

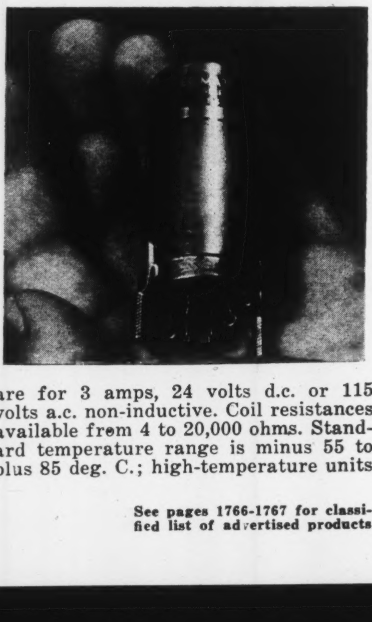


**Mention No. 1691 when filling out card.**

## COMPONENTS

### Sealed Relay

New relay with hermetic seal of either air of inert gas has sensitivity as low as 0.010 watt and operates with as low as 0.0008 amp. SPDT contacts are for 3 amps, 24 volts d.c. or 115 volts a.c. non-inductive. Coil resistances available from 4 to 20,000 ohms. Standard temperature range is minus 55 to plus 85 deg. C.; high-temperature units



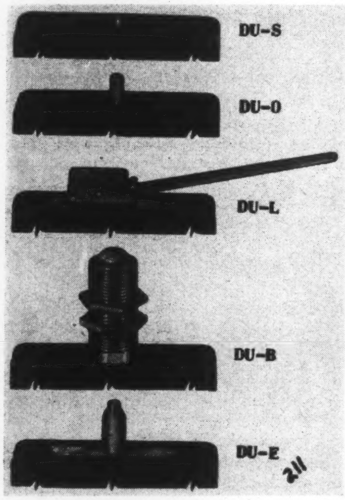
See pages 1766-1767 for classified list of advertised products

may be ordered to 200 deg. C. Shock and acceleration in excess of 50g. Operates within 3 milliseconds. Weight is 2.14 oz. Available as a plug-in or solder hook unit with variety of mounting brackets.—*Neomatic, Inc., Los Angeles, Calif.*

**Mention No. 1692 when filling out card.**

### Limit Switch

New "du•op" limit switch is now available with four new types of actuators—"Type DU-O" has nylon plunger; "DU-L" has leaf actuator requiring light operating pressures and may be set to any of three leverage positions; "Type DU-B" may be actuated from side or at any angle by ball actuator, "Type DU-E" has stainless-steel plunger. Switch is rated at 20 amp. 125 volts a.c.—*General Control Co., Boston 34, Mass.*



**Mention No. 1693 when filling out card.**

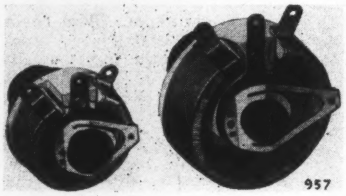
### Selenium Diodes

New "Type 1S1" and "Type 5U1" have been added to maker's line of subminiature diodes. "Type 1S1" is rated for max. input of 26 volts rms. at 100 microamps output; "Type 5U1" for 130 volts max. at 1.5 milliamps.; both operate in ambient temperature range of 50 to 100 C.; are completely encapsulated in thermosetting plastic. —*International Rectifier Corp., 1521 East Grand Ave., El Segundo, Calif.*

**Mention No. 1694 when filling out card.**

### Ring-type Rheostats

New "Bulletin 1110" 25- and 50-watt "Vitrohm" ring type rheostats, designed for rheostat or potential-di-



made right to work right

**BENDIX-FRIEZ**

high-precision thermistors

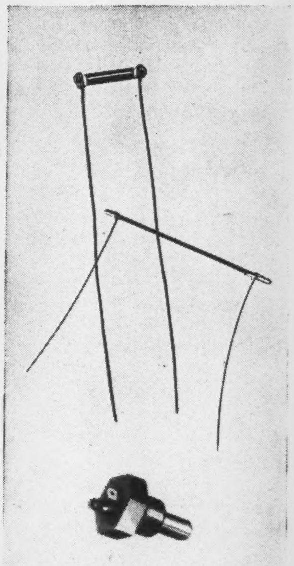
Whether you use these temperature responsive resistors in standard or special models, you can be sure of this. *They'll match your needs* for resistance values, size, temperature coefficient, mountings and quality. Made in our own plant under carefully controlled conditions, Bendix-Friez Thermistors know no equal.

**STANDARD TYPES FOR IMMEDIATE DELIVERY**

| Size (inches) | @ +30°C. | @ 0°C. | @ −30°C. |
|---|---|---|---|
| .140 x .75 | 45.0 ohms | 86 ohms | 194 ohms |
| .040 x 1.5 | 12,250 ohms | 26,200 ohms | 65,340 ohms |
| .018 x 1.5 | 35,000 ohms | 82,290 ohms | 229,600 ohms |

*Write for details.*

**FRIEZ INSTRUMENT DIVISION of . .**
**1408 Taylor Avenue, BALTIMORE 4, MARYLAND**
Export Sales: Bendix International Division
72 Fifth Avenue, New York 11, N. Y.



Used in this typical application for sensing the temperature of hydraulic oil.

Bendix
AVIATION CORPORATION

Pneumatic Weight Transmitters

**FOR LINEAR CONVERSION OF WEIGHT INTO POUNDS PER SQUARE INCH AIR PRESSURE**

A complete line of weight transmitters in single and multiple diaphragm construction with load capacities up to 23,000 pounds per diaphragm. Pneumatic tare balance for any portion of the total load on all models. All moving parts are enclosed totally. Complete weighing systems designed to your requirements.

*WRITE FOR CATALOG*

**JOHN R. MONSELL**
*Manufacturing Engineer*
Pitman, N. J.

BECO
IMPEDANCE BRIDGE
for
measurement
of
RESISTANCE ◆ CAPACITANCE
INDUCTANCE
◆ Compact—9" x 11" x 11" over-all
◆ Exceptionally accurate ◆ Wide ranges ◆ Convenient operation from battery, or AC power line accessory amplifier ◆ Features exclusive DEKADIAL for high precision readings.

Shown: Model 250-C. Many laboratories now install several compact Beco Bridges for flexibility and utility. Write to factory for costs, details, and an analysis of your needs. No obligation.

BECO
BROWN ELECTRO-MEASUREMENT CORP
[illegible]-37 S. E. HAWTHORNE BLVD PORTLAND 15, OREGON

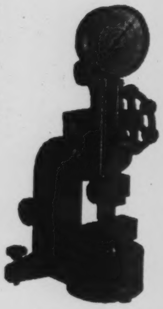
HARDNESS TESTING...
done WITH NO MENTAL HAZARDS. The SCLEROSCOPE has done it for the past 42 years.

In general use for specification purposes. Simple, sturdy. Comparatively inexpensive.

•

*Illustrated bulletins free*

The Shore Instrument & Mfg. Co., Inc.
90-35 Van Wyck Expressway
Jamaica 2, N. Y.



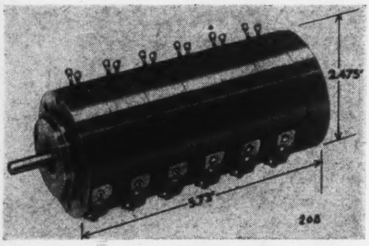
High Precision Optical Components Any Size For Astronomical and Physical Research
•
Parabolic, Spherical, Ellipsoidal and Plane Mirrors
•
Plane Parallel Plates
•
Schlieren Systems
•
Wind Tunnel Optics
•
Lenses & Prisms of Glass Natural or Synthetic Crystals
•
Complete Optical and Mechanical Instruments
•
Made to Specifications
•
High Vacuum Coating
•
John Unertl Optical Co.
3551-3555 East Street
Pittsburgh 14, Penna.

vider use in electronic and industrial control equipment, feature a new contact-arm and drive-shaft assembly that furnishes smooth, close control with no backlash. Both core and base are molded of high-density low-porosity and high-dielectric-strength ceramic. High-stability resistance wire is secured by vitreous enamel. Watt ratings are based on 300 C. rise in 40 C. ambient. Resistance values for 50-watt size range from 1 to 7500 ohms.—*Ward Leonard Electric Co., Mount Vernon, N. Y.*

**Mention No. 1695 when filling out card.**

## Ganged Phasing Resistor

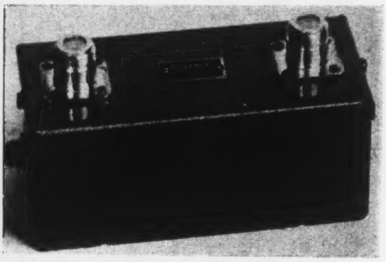
New "Gangpot" is vernier-phasing ganged voltage-dividing resistor of instrument quality. Available with from two to six individual sections. Six-section unit operates on 1.5 oz.-in. shaft torque. Assembly is without external clamps or bolts. Mechanical rotation is 360 deg. continuous; electrical rotation is 360 deg. or less. Available in resistances from 2000 to 300,000 ohms, 4 watts. Linear or nonlinear outputs, one or two brushes, and taps as desired. Screwdriver vernier phasing for each section permits phasing to 0.2 deg. over angle of 22 deg.—*G. M. Giannini Co., Inc., Pasadena, Calif.*



**Mention No. 1696 when filling out card.**

## Variable Delay Line

New "Type 601" step-variable delay line features faithful reproduction of input signal pulses, freedom from time jitter, and no limit on repetition rate. Consists of 44 sections of lumped-parameter L-C networks. Produces essentially zero over-shoot. Time delay is variable in steps of 0.2 usec. up to 2.2 usec. Characteristic impedance is 190 ohms. Rise time is less than 0.1 usec. Cutoff frequency is 6.37 Mc. Maximum input voltage is 500 volts peak.—*Advance Electronics Co., P. O. Box 394, Passaic, N. J.*

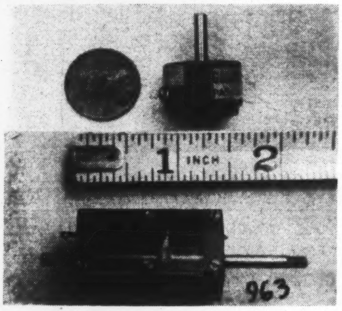


**Mention No. 1697 when filling out card.**

See pages 1766-1767 for classified list of advertised products

## Precision Voltage Dividers

New line of precision voltage-dividing resistors ("potentiometers") comprises subminiature types for telemetering and electronics industries. Rotary

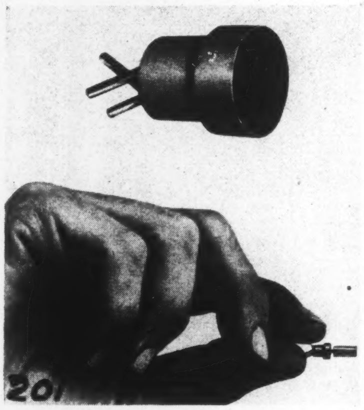


"Type RC" can be furnished up to 320,000 ohms with a resolution of 0.1 percent, in a ¾ in diameter case. Rectilinear "Type LE" in a case 1⅜ in. long, can be furnished up to 1,000,000 ohms with a resolution of 0.05 percent.—*Galetronics, Inc., c/o Eastman-Pacific Co., 2320 E. 8th St., Los Angeles 21, Calif.*

**Mention No. 1698 when filling out card.**

## Transistor Sockets

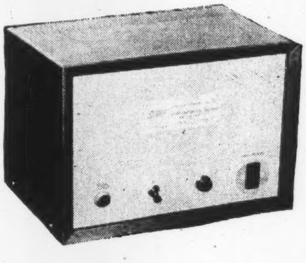
New "Mycalex 410" transistor sockets have glass-bonded mica insulation for lasting dimensional stability, low dielectric loss, immunity to high temperature and humidity exposure, combined with maximum mechanical strength. Loss factor is 0.014 at 1 Mc.; dielectric strength is 400 volts/mil. Contacts can be supplied in brass or beryllium copper. Holes for leads are said to be smallest ever molded.—*Mycalex Tube Socket Corp., 60 Clifton Blvd., Clifton, N. J.*



**Mention No. 1699 when filling out card.**

## Seven-inch C-r. Tube

New "7VP1" 7-inch, cathode-ray tube gives sharp focus and provides high trace brightness in general oscillographic applications; utilizes electrostatic focus and electrostatic deflection; has same shape, dimensions, basing, and deflection factors as "7JP1," but gives superior resolution of a line trace compared with the 7J-types which were


SERVOTHERM PRODUCTS

BOLOMETER AND PREAMPLIFIER

Thermistor bolometers are FAST, sensitive INFRARED and HEAT detectors. Especially RUGGED for industrial, scientific, and military applications. PREAMPLIFIER provides NOISE-FREE initial amplification and mount.

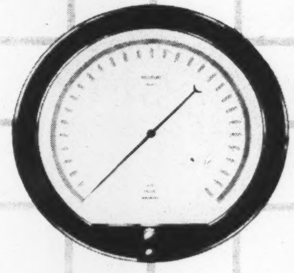
THERMISTOR POWER SUPPLY

Provides voltages required by BOLOMETER bridge and PREAMPLIFIER. Regulated and filtered permitting THEORETICAL NOISE LIMITS of amplification, while operating from 60 CYCLE line.

SERVO

SERVO CORPORATION OF AMERICA

DEPT. IN-12 NEW HYDE PARK, N.Y.


calibration standard for pressure gauge production

HEISE GAUGES

- SUSTAINED ACCURACY
- QUICK RESPONSE
- EASILY-READ SCALE

Close accuracy sustained in continuous use, even at full scale, has established Heise Bourdon Gauges as test standard for many manufacturers of pressure gauges. Also used for testing pressure actuated switches and controls. Zero adjustment is easily made with external knob.

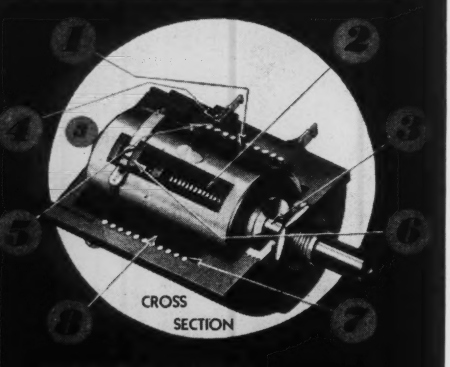
Heise Gauges are used in many industries for precise measurements of pressure. Custom-built in pressure ranges from 0-15 to 0-10,000 psi. Sizes: 8½", 12", and 16" diameter. Standard gauges from $151.60 to $211.20. Accessories extra. Write for catalog.

Heise Bourdon Tube Company, Inc.
Newtown, Connecticut

MICROPOT

PRECISION TEN-TURN POTENTIOMETER

1. You get permanent accuracy because the resistance wire is locked in place. It is precision positioned and moulded integrally with the housing.
2. You get permanently accurate settings, smooth action and low uniform torque provided by the stainless steel, precision ground, double thread lead screw guiding the moving contact.
3. You get precise positioning of the moving contact because of the two bearings supporting the rotor assembly.
4. You get good rigid terminals because they are moulded integrally with the housing.
5. Terminals soldered to ends of resistance element before moulding. Entire resistance circuit is an integral part of the housing.
6. You get accurate setting and resetting due to anti-backlash spring in contact guide.
7. You get a fine resolution because of the 43½" length of resistance wire in the spiral element.
8. You get a resistance output directly proportional to shaft rotation within ±0.1% of the total resistance. Every potentiometer is automatically machine tested for linearity at 101 points.



LINEARITY ACCURACY ± 0.1%

Units for immediate shipment:
1,000 to 30,000 ohm range.
Special resistance values made to order.

WRITE TODAY FOR ENGINEERING INFORMATION

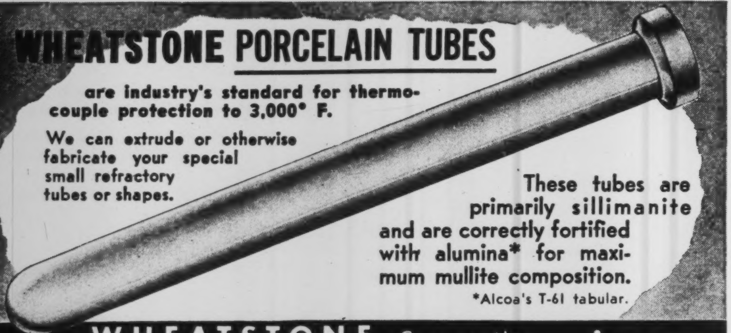
MICROPOT BORG

BORG EQUIPMENT DIVISION
THE GEORGE W. BORG CORPORATION
JANESVILLE • WISCONSIN

WHEATSTONE PORCELAIN TUBES

are industry's standard for thermocouple protection to 3,000° F.

We can extrude or otherwise fabricate your special small refractory tubes or shapes.



These tubes are primarily sillimanite and are correctly fortified with alumina* for maximum mullite composition.

*Alcoa's T-61 tabular.

WHEATSTONE Corporation
2436 Reading Road
Cincinnati 2, Ohio
FACTORY
FOSTER, KY.

MICRO COLLINS FLAT

BLACK GRANITE SURFACE PLATES

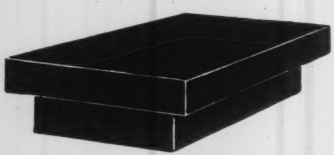
PERFECT PRECISION

Avoid substitutes

Immediate delivery in most sizes from 9x12 to 48x144.

REQUEST BULLETIN and name and address of Distributor nearest you.

Present an absolute continuous bearing surface, finished up to 50 millionths inch. Incredibly smooth. Falling objects do not cause humps. Being harder than hardened steel, can take greatest mistreatment without causing inaccuracy of surface. No oiling. Will not rust or warp. No re-scraping. Most durable.



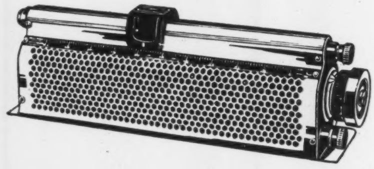
COLLINS MICROFLAT CO., 2326 East 8th Street, Los Angeles 21, Calif.

designed for high brightness in a television raster.—*Tube Dep't, Radio Corp. of America, Harrison, N. J.*

**Mention No. 1700 when filling out card.**

## Vernier Rheostat

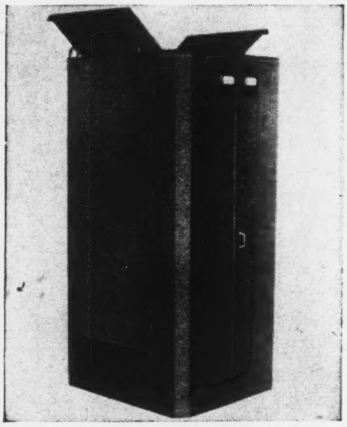
New vernier rheostat for extremely fine control of current and voltage combines a standard tubular rheostat with a turnable vernier rheostat in series or in parallel connections. Each step on vernier has about 1/10th of ohmic value of one winding of main rheostat. Each rheostat is provided with a dial for exact settings of slider positions.—*Rex Rheostat Co., 3 Foxhurst Road, Baldwin, L. I., N. Y.*



**Mention No. 1701 when filling out card.**

## Load-testing Resistor

New "Type TT-148" standardized loading resistor for load-testing diesel-electric power plants rated up to 2,500 hp. consists of 12 resistor trays, a motor-driven blower, knife switches, bus bars, and measuring instruments. Resistor-section connections make possible ten different series-parallel combinations.—*Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 30, Penna.*



**Mention No. 1702 when filling out card.**

## High-voltage Capacitors

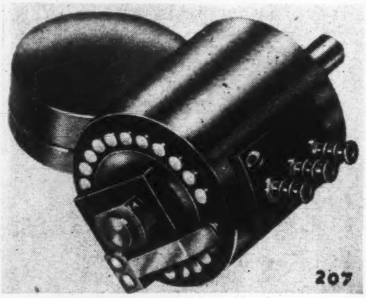
New "Hi-Q" ceramic capacitors of slug, disk, plate and tubular types are available in voltage ratings of 1 to 20 kv. Terminals are silvered brass integrally soldered to silver electrodes fired directly to ceramic dielectric. Insulation resistance is of the order of 50,000 megohms. Working voltage 20,000 v.d.c.; flash test 27,000 v.d.c.—*Aerovox Corp., Olean, N. Y.*

**Mention No. 1703 when filling out card.**

See pages 1766-1767 for classified list of advertised products

## Miniature Attenuator

New "Series 120" miniature attenuator, 1 3/8 inch in diameter x 1 29/32 inch deep, is particularly suitable for use where space is at a premium. Available in 20 steps having a ladder or pot network. All standard decibel steps and various impedances up to 500,000 ohms are available. Resistor accuracy is 5 percent and power dissipation is 0.6 watt.—*The Daven Co., Dept. A,* 191 *Central Ave., Newark* 4, *N. J.*



**Mention No. 1704 when filling out card.**

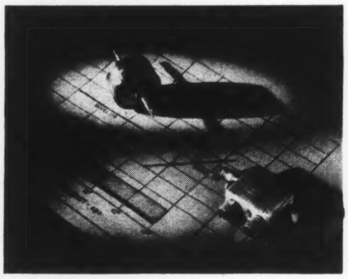
## Carbon-film Resistors

New high-stability carbon-film resistors are sealed in glass envelopes, evacuated, baked at high temperature under vacuum, and finally sealed in helium of spectroscopic purity. Units are stable to 0.01 percent under all environmental conditions; have long-time drift of 0.01 percent per year or less.—*Chase Resistor Co.,* 9 *River St., Morristown, N. J.*

**Mention No. 1705 when filling out card.**

## Wideband Directional Couplers

New Wideband Directional Couplers, applicable for measuring numerous parameters relating to transmission lines, are available in three models, "137" and "138" for frequency range 30 to 1500 Mc. and "139" for 10 kc. to 1 Mc. Operating characteristics are shown in accompanying illustration. New couplers, with suitable additional



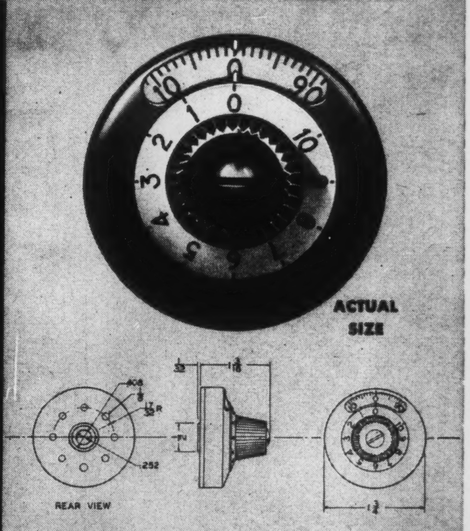
# MICRODIAL
TEN TURN-COUNTING DIAL

Microdial is composed of two concentrically mounted dials . . . one for counting increments of each turn and the other for counting turns. The incremental dial has 100 equal divisions and is attached rigidly to the shaft so there is no backlash. Thus the contact position is indicated to an indexed accuracy of 1 part in 1000. Rotation is continuous in either direction. There are no stops on the Microdial assembly.

**COMPACT . . .** Microdial has same O.D. as Micropot . . . requires no more panel space.

**CLEAR READING . . .** Forced fast-reading tests showed only 1/20th as many errors with Microdial open window as with next most legible dial. Turn counter distinguishes between 0 and 10 turn readings, and accelerates to avoid confusion on readings near integral turns. Precise readings are made from larger dial with maximum separation of graduations and wide angle visibility.

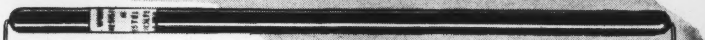
**CONVENIENT . . .** delivered completely assembled with dials synchronized. Easily mounted in a few seconds. All dials may be locked.



**Microdial . . . turn-counting dial, primarily designed for use on Micropot ten turn linear potentiometers . . . use it on any multiturn device having ten turns or less.**

BORG EQUIPMENT DIVISION
**THE GEORGE W. BORG CORPORATION**
JANESVILLE • WISCONSIN

# *The* S. S. WHITE 80X HIGH VOLTAGE RESISTOR



**(½ Actual Size)**

**4 watts • 100 to 100,000 megohms**

Developed for use as potential dividers in high voltage electrostatic generators, S.S.White 80X Resistors have many characteristics — particularly negative temperature and voltage coefficients—which make them suitable for other high voltage applications.

They are constructed of a mixture of conducting material and binder made by a process which assures adequate mechanical strength and durability. This material is non-hygroscopic and, therefore, moisture-resistant. The resistors are also coated with General Electric Dri-film which further protects them against humidity and also stabilizes the resistors.

**WRITE FOR BULLETIN 4906**

It gives complete information on S.S.White resistors. A free copy and price list will be sent on request.

S.S.White
MOLDED RESISTORS

**THE S.S.White DENTAL MFG. CO. INDUSTRIAL DIVISION**
Dept. I, 10 East 40th St.
NEW YORK 16, N. Y.
Western District Office • Times Building, Long Beach, California

VECO

VICTORY
Thermistors

**BEADS**
**DISCS**
**RODS**
**WASHERS**

**CHECK THESE IMPORTANT POINTS**

- Full line of standard thermistors available from stock
- Special thermistors engineered to customers' requirements
- We make all Western Electric type thermistors
- Our thermistors have exceptionally high temperature coefficient and stability
- Technical assistance in your design and engineering problems

A Few Common Uses:

Time delay • Gas analysis • Volume limiting • Surge protection • Vacuum manometry Flow measurement • Temperature control • Temperature measurement • Radar power measurement • Temperature compensation • Oscillator stabilization • and a host of new applications being developed every day.

*Send for free literature.*

Victory
ENGINEERING CORPORATION
Springfield Road
UNION, NEW JERSEY

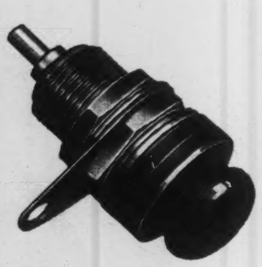
**Telephone UNionville 2-7150**

instrumentation, permit reflection coefficient to be determined directly, simplifying several important transmission-line measurements.—*Sierra Electronic Corp., 831 Brittan Avenue, San Carlos, Calif.*

**Mention No. 1706 when filling out card.**

## Aircraft-type Indicator Light

New "Type L1000" panel indicator light weighs approx. ¼ oz. Terminal is rigidly molded in place. Removable plastic lens, available in amber, blue, green, red or white, is held securely by a rubber "O" ring which also serves as moisture seal. Standard 6-, 12- or 28-volt No. 327 miniature lamp is used. *Hetherington, Inc., Sharon Hill, Pa.*



**Mention No. 1707 when filling out card.**

WANTED—
PRODUCTION MANAGER

with engineering degree, to plan and supervise very specialized production and personnel in a rapidly growing engineering organization devoted to the design and manufacture of small instrument type parts. An engineering background with exceptional coordinating ability in production and quality control is essential. WELTON V. JOHNSON ENGINEERING COMPANY, INC., 95 Summit Ave., Summit, N. J.

INSTRUMENTATION ENGINEER, M.E., M.S., over 20 years experience with major instrument and construction companies. Estimations, applications, specifications, purchasing set-up. Box 227, Instruments Publishing Company, 921 Ridge Avenue, Pittsburgh 12, Penna.

## INSTRUMENT EVENTS Calendar

**Jan. 6**
Society for Applied Spectroscopy regular meeting at Socony-Vacuum Training Center, New York. Subject will be "Computation of Analytical Results." For information write G. L. Crumrine, North American Smelting Co., Marine Terminal, Wilmington 83, Delaware.

**Jan. 8-9**
Computation Symposium to be held in Kansas City, by Midwest Research Institute. For information write Martin Goland, Midwest Research Institute, 4049 Pennsylvania Ave., Kansas City 2, Missouri.

**Jan. 14-16**
Third Conference on High-frequency Measurements. Sponsored by AIEE, IRE, and NBS. To be held in Washington, D. C.

**Jan. 26-29**
120th Meeting, American Meteorological Society, New York, N. Y. For information write Kenneth C. Spengler, Ex. Sec., 3 Joy St., Boston 8, Mass.

**Jan. 26-30**
Twenty-First Annual Meeting, Institute of Aeronautical Sciences, Hotel Astor, New York, N. Y. For information write Robert R. Dexter, Sec., 2 East 64 St., New York 21, N. Y.

**January 29-31**
Eighth Annual Symposium "Instrumentation for the Process Industries" Agricultural & Mechanical College of Texas, College Station, Texas. For information write Dr. P. G. Murdoch, Director of the Symposium.

**Feb. 4-6**
First meeting Western Computer Conference sponsored by joint Computer Conference Committee of Institute of Radio Engineers and the American Institute of Electrical Engineers. Hotel Statler, Los Angeles, Calif.

**Feb. 2-6**
Sixth Annual Symposium on Modern Methods of Analytical Chemistry, Louisiana State University, Baton Rouge, La.

**Feb. 18**
Annual Meeting, New York Section, Instrument Society of America, Statler Hotel, New York, N. Y. For information write R. A. Hutcheon, 45-65 196th St., Flushing 58, N. Y.

**Mar. 2-6**
Pittsburgh Conference and Exposition on Analytical Chemistry and Applied Spectroscopy, William Penn Hotel, Pittsburgh, Pa. For information write L. E. Pitzer, c/o U. S. Steel Co., 525 Wm. Penn Place, Pittsburgh 30, Pa.

**Mar. 17-19**
121st Meeting American Meteorological Society, Atlantic City, N. J. For information write Kenneth C. Spangler, Ex. Sec., 3 Joy St., Boston 8, Mass.

**March 23-26**
I.R.E. National Convention & Radio Engineering Show. Grand Central Palace, New York, N. Y. For information write W. Copp, 303 West 42 St., New York 18, N. Y.

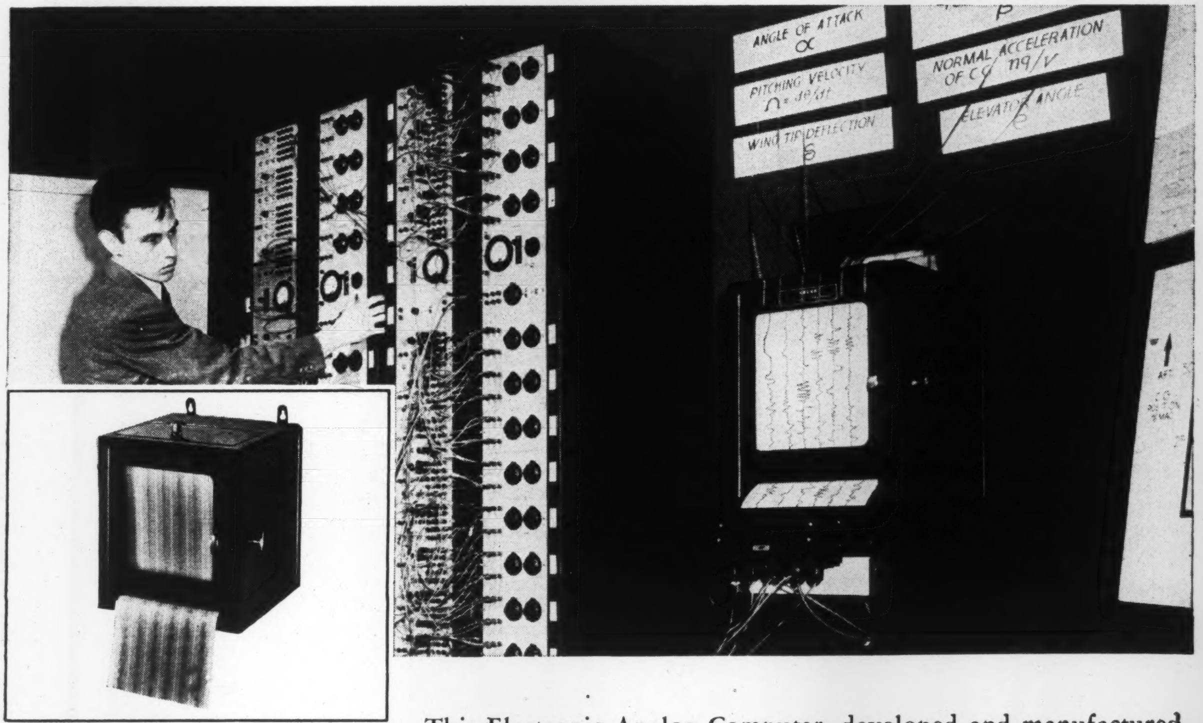
**Mar. 23-25**
13th Annual Meeting, American Congress on Surveying and Mapping, Hotel Shoreham, Washington, D. C. For information write Walter Dix, Ex. Sec., Box 470, Benjamin Franklin Sta., Washington 4, D. C.

**Mar. 26-27**
Instrumentation for the Iron and Steel Industry, Roosevelt Hotel, Pittsburgh, Pa. For information write Dr. Axel H. Peterson, Secretary, Pittsburgh Sec., Instrument Society of America, c/o Mellon Institute, 4400 Fifth Ave., Pittsburgh 13, Pa.

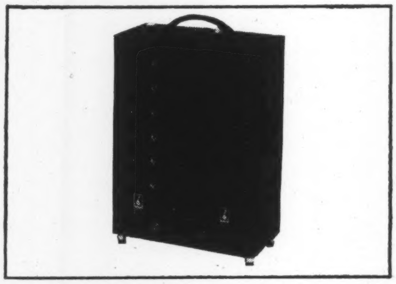
**April 7**
Fifth Annual Symposium, New Jersey Section, Instrument Society of America, entitled "Management, Labor, and the Instrument Department." Hotel Essex House, Newark, N. J. For information write L. H. Ballinger, 2371 Channing Ave., Westfield, N. J.

**September 21-25**
Eighth National Instrument Conference & Exhibit, Sherman Hotel, Chicago, Ill. For information write P. V. Jones, Mgr., Instrument Society of America, 1319 Allegheny Ave., Pittsburgh 33, Pa.

# Electronic Computer gets the answers...
# BRUSH PUTS THEM IN WRITING!



**RECORDS SIX VARIABLES SIMULTANEOUSLY.** The Brush six-channel Magnetic Oscillograph is designed for simultaneous recording of six electrical and/or mechanical phenomena, with a chart record instantaneously available. This instrument facilitates multiple strain measurement, vibration analysis, wind tunnel work, circuit analysis, etc. Built-in gear changer provides instantaneous shift from high to low speed; wide choice of chart speeds available. Furnished for ink writing or combination electric and ink writing.



**RECORDS SIX VARIABLES CONSECUTIVELY.** If simultaneous strain measurements are not necessary, consecutive measurements can be made with substantial saving in equipment cost. The Universal Bridge Switch, when coupled with a Brush Universal Analyzer and two-channel Magnetic Oscillograph, permits consecutive recording of strain measurements from six different locations on the structure or specimen being tested. One of the two channels of the oscillograph records strain, the other channel indicates the location of the particular strain measurement.

This Electronic Analog Computer, developed and manufactured by the Boeing Airplane Company, permits engineers to explore problems in all their variations at one time. Hours of laborious calculations are eliminated.

With the use of the Brush six-channel Oscillograph, results from as many as six different computations are recorded simultaneously. Plotting of results is not necessary, since the Brush Oscillograph provides permanent chart records—immediately!

Boeing uses Brush Recorders extensively in their analog computer activities and indicates that their experience with this equipment has been very satisfactory.

Investigate Brush Recording Analyzers for your studies . . . in the laboratory, on the test floor, in the field. Expert technical assistance from Brush representatives located throughout the U.S. In Canada: A. C. Wickman, Limited, Toronto.

*For complete information write The Brush Development Co., Dept. A-43, 3405 Perkins Ave., Cleveland 14, Ohio.*

**PUT IT IN WRITING WITH A BRUSH RECORDING ANALYZER**

THE *Brush*
DEVELOPMENT COMPANY

BRUSH

**Piezoelectric Crystals and Ceramics**
**Magnetic Recording Equipment**
**Acoustic Devices**
**Ultrasonics**
**Industrial & Research Instruments**

# Sources and Control of RIVER POLLUTION

**Stream pollution is a vast, growing, and complicated problem. Important factors include sources and types of pollution, stream self-purification properties, and instruments for the measurement and control of pollution.**

**By RICHARD D. HOAK**
**Mellon Institute**

TODAY, in our modern communities, it is difficult to conceive the insanitary conditions under which mankind lived only a century ago. Streets and gutters were the common receptacles for all manner of filth and refuse. Health was normally bad in such an environment, and epidemics regularly took an appalling toll of lives in the cities. The installation of conduits for water carriage of sewage effected an almost immediate improvement in public health, but the receiving streams promptly became degraded, and stream pollution first became troublesome as a result.

As invention succeeded invention, the population of the western world not only increased but tended to concentrate in large manufacturing centers. Since industry generally requires an ample supply of water for its operations, and often depends on waterways for transport of finished goods, it was natural for manufacturing enterprises to locate near rivers. Streams that were adequate for assimilation of the wastes from agricultural communities became unable to carry the extra burden, and pollution became serious.

Stream pollution developed gradually. It became a complex problem before the public became aware of it. It was recognized widely only about 30 years ago, and there has been a concerted effort to establish workable controls for little more than half that period. Now 46 states have passed legislation to abate stream pollution, and in 1948 a Federal law was enacted to provide the states with various kinds of aid to strengthen their own efforts.

## SOURCES OF POLLUTION

Pollution of surface water occurs in many different ways, some of which are not properly taken into account when stream improvement programs are planned. The principal sources of pollution are (1) erosion, (2) storm-water runoff from urban areas, (3) domestic sewage, (4) industrial waste, and (5) acid mine water.

### *Erosion*

When stream pollution is discussed, the serious effects of land erosion are often ignored. But silt flushed into streams by storm water can be as destructive as other pollutants. In recent years the loss of soil in this manner has reached alarming proportions. The annual mudload of the Potomac River at Washington has been estimated at 1,700,000 tons. This is equivalent to six inches of topsoil from 1300 acres. The Mississippi River carries 300,000,000 tons of silt annually to the Gulf of Mexico. In addition to loss of soil from farms and cut-over timber lands, highway construction and similar operations requiring extensive excavation contribute significantly to land erosion.

Silt causes a variety of adverse effects. It destroys natural spawning grounds and thereby reduces a normal production of fish. Also, it destroys fish by damaging their gill tissues. It robs streams of dissolved oxygen, reducing the beneficial effects of sunlight. Excessive turbidity increases the cost of public and industrial water supplies by silting reservoirs and multiplying the expense of purification. Navigable streams must be dredged to maintain adequate channels, and flood damage is often increased by mudbanks in rivers.

The increasing adoption of soil-conservation practices has considerably reduced erosion of farm lands, but no generally satisfactory solution to the erosion problem is yet in sight.

### *Runoff from Urban Areas*

The storm water that flushes the buildings and streets of cities is not often included as a factor in stream pollution, yet it causes its share of damage. Rain washes toxic substances from the smoke and fumes above urban communities and flushes organic matter from storm-water catch basins. Also, municipalities that have combined sanitary and

---

Presented at the Conference "Instrumentation for the Iron & Steel Industry," April, 1952, Pittsburgh, Pa.

storm-water sewage systems generally install by-passes in trunk sewers to divert all flows in excess of a hundred per cent of the dry-weather flow to protect their sewage-treatment plants.

It may be argued that dilution of streams by rainfall offsets any damage it might cause. This is partly true. A long-continued, moderately heavy rain will supply water of steadily improving quality as cities are washed cleaner, but a heavy shower of short duration might cause an adverse alteration in stream balance. Obviously, little can be done to overcome pollution from this source.

### *Domestic Sewage*

Streams are the natural drainage channels of the land, and they have long been used to carry away human wastes. The development of water carriage of sewage greatly increased pollution, and as urban areas grew in size many streams became so degraded that community health and downriver water supplies were endangered. It was this danger to public health that originally prompted legislation aimed at reducing pollution. Today, regulations governing discharge of wastes to streams are stringent in nearly every section of the country.

Approximately half the population of this country is served by sewers but, in spite of the law and the more than 6600 sewage-treatment plants in operation, about 40 percent of the sewage from sewered communities is discharged untreated. Since the ultimate biochemical oxygen demand of domestic sewage averages 0.245 pound per capita, and because water saturated with oxygen at 20 deg. C. contains about 75 pounds of dissolved oxygen per million gallons, a million gallons of water is required to assimilate the sewage from about 150 persons without reducing the dissolved oxygen in the stream below 50 percent of saturation.

Over the country, discharge of untreated or partially treated sewage constitutes roughly half the total pollutional load on streams. Although abatement of this kind of pollution is a community responsibility, many municipalities have failed to provide adequate sewage treatment, even when financially able to do so. Unfortunately, such facilities do not excite as much civic pride as a new park or school building. Public demand and stricter law enforcement, however, are now gradually overcoming community reluctance.

### *Industrial Wastes*

An inescapable byproduct of all industrial activity is waste material. Many industrial wastes are solids, and these are of minor importance as stream pollutants except where they are carried in suspension by waste water. Industry also produces a wide variety of liquid wastes whose volume and composition are largely unpredictable. Not only do the wastes of companies making similar products differ greatly, but the characteristics of waste waters change continually as production rates fluctuate, as different stocks are processed, and as new processes are introduced. This variability prevents standardization of treatment methods, and each waste-disposal problem requires an individual solution.

There is a widely-held misconception that industrial wastes contain valuable substances that can be recovered. In the past, much useful material that is now salvaged was discharged to streams. However, industry today is alert to every proposal that will lead to reduction or economical recoveries of waste. Research is being increasingly directed to development of sound methods for utilizing industrial wastes.

### *Acid Mine Water*

Oxidation of pyrites in coal mines has created a serious pollution problem. As the iron sulfide in coal reacts with air and moisture, a solution of ferrous sulfate is formed. This solution has an acid reaction, and it dissolves various minerals in the mines. Nearly all coal mines collect water that must be pumped or drained away to prevent flooding of the workings. The water so discharged frequently carries a high concentration of dissolved salts, principally sulfates of iron, aluminum, calcium, and magnesium. An enormous and steadily increasing volume of water flows from mines, causing serious stream damage. Much of the most strongly acid water does not come from active workings, which are usually well-drained, but from abandoned mines and stripping operations. It has been estimated that 1200 tons of dissolved iron flow past the Pittsburgh Point every day.

Research is in progress to develop ways to abate pollution from this source. No practical solution to the problem has evolved.

## VARIETIES OF POLLUTION

Stream pollutants fall into four broad groups: inert, toxic, inorganic, and organic. These often overlap; a particular waste may contain representatives of all groups, or a toxic agent may be an organic compound.

*Inert* material, like sand or silt, settles out of water and blankets fish spawning grounds and organisms that live in the stream bed. Finely divided material can remain in suspension for a long time; the turbidity it creates interferes with the beneficial effects of sunlight.

*Toxic* substances kill aquatic life by contact or by absorption. It is not a simple matter to define toxicity, but it is always a function of concentration. Our knowledge of concentrations causing adverse effects is still scanty, but studies are being made to establish upper limits for most compounds known to be toxic in low concentration.

*Inorganic* compounds normally comprise the common acids and alkalies and their salts, but almost any inorganic substance may be present. These compounds often react with dissolved mineral and organic material in streams, and some of them absorb oxygen.

*Organic* matter creates by far the most serious pollution problems because it is a readily available food for microscopic plant and animal life. Organic substances are decomposed by bacteria, and this process uses oxygen dissolved in the water. As the organic load increases, the oxygen demand increases proportionately, and dissolved oxygen may be reduced below the level necessary to support the higher types of aquatic life.

### SELF-PURIFICATION OF STREAMS

A stream is not merely a mass of water flowing rapidly or slowly from a higher to a lower level. It is a complex chemical and biological medium in which a great variety of interdependent processes exist together in a state of dynamic equilibrium. As one group of factors gains ascendancy and forces the equilibrium in one direction, another group is stimulated to greater activity in compensation. Aquatic plant and animal life play a dominant role in the complicated system of forces that is constantly active in streams. Wherever waste water is to be discharged to a stream it is important to recognize the ways in which it may affect stream ecology.

Coal dredging operation.

There is a strong tendency in nature for all matter to seek the level of greatest stability—that is, nature tends toward a condition of increasing entropy, or lack of availability of energy to do work. Organic matter, the product of life, is formed by biosynthesis from inorganic materials. After a relatively short time among living things it returns, by the processes of decay, to the inorganic world. Growth and decay form a cycle in which mineral matter is constantly being raised (by energy from the sun) to organic forms which, in turn, revert to inorganic substances, again to be transformed. Decay results from biochemical reactions which release energy as some form of work, and thereby change the high-level energy of organic matter to the low-level energy of inorganic compounds. This process broadly involves oxidation, though oxygen itself does not always play a direct role in the reaction.

#### *Bacteria*

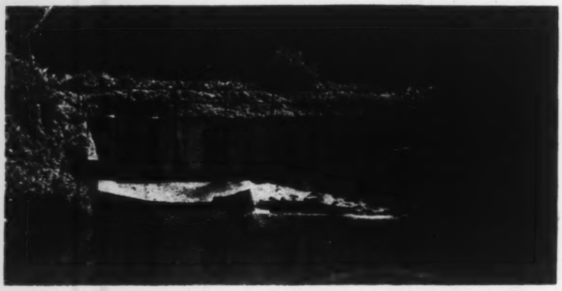
Every stream contains bacteria, practically all of which are beneficial to mankind; indeed, life as we know it could not exist without the accommodating activities of bacteria. This microscopic life utilizes organic matter as food by several complex processes that collectively may be called digestion, though the technical term is respiration. But the bacteria that convert organic substances into odorless gases and non-putrescible humus require oxygen to live. This they obtain from the small amount dissolved in the water. As the amount of food increases, the micro-organisms multiply very rapidly and the need for oxygen also increases. If the organic load increases to a point at which the water cannot supply enough oxygen to support the bacteria that have developed in response to the plentiful food, conditions in the stream change markedly; bacteria that require oxygen in their life cycle disappear, and their place is taken by other species that can live without oxygen. When these organisms utilize organic matter they convert it into nauseous gases, the stream turns black, and all higher forms of life are destroyed.

#### *Dissolved Oxygen*

Although many factors are important in maintaining a healthy environment for stream biota, enough dissolved oxygen to provide inoffensive assimilation of organic material is by far the principal one. Oxygen is dissolved from the surrounding atmosphere, but its solubility is limited and its rate of solution depends on the amount of surface exposed. For this reason, deep sluggish streams dissolve oxygen more slowly than turbulent ones. On the other hand, the rate of solution of oxygen is directly proportional to the degree of unsaturation of the water—that is, the greater the oxygen demand the higher the rate of reaeration. Also, the actinic rays of the sun, through a mechanism known as photosynthesis, cause plants to convert chemical foodstuffs into plant substance. A by-product of this process is the evolution of oxygen, which is an important source of oxygen in streams and lakes. If plants are to perform this function, however, it is necessary for the water to be reasonably clear. Photosynthesis does not occur where water is so turbid that light cannot penetrate more than a few inches.

#### *Other Factors*

Other significant factors affecting stream biota are temperature, pH, dissolved solids, and toxins. Excessive temperature is a pollutant in the same sense as dissolved or suspended substances. It increases chemical and biological activity, and, at the same time, decreases the amount of oxygen the water can hold in solution. Many life forms die if their environment is too warm. However, where a temperature uniformly higher than normal is maintained, some organisms may gradually acclimate themselves to the changed conditions.



Factory discharges waste water into an old canal.

A rather narrow range of pH is characteristic of streams unaffected by human agency, but the range varies considerably in geographically different areas. In general, pH is not a critical factor, and a range of roughly 6 to 8 will usually provide a healthy environment.

Dissolved solids create an adverse condition when they rise above a fairly definite maximum. The tolerance for dissolved salts varies with the species, but a concentration above about 500 ppm. is deleterious to most higher life forms. This results from the physical phenomenon of osmosis, which causes water to flow through semi-permeable membranes from a region of low concentration of dissolved salts to one of higher concentration. Fish have actually been dehydrated by placing them in a bath containing a high concentration of otherwise inert salts.

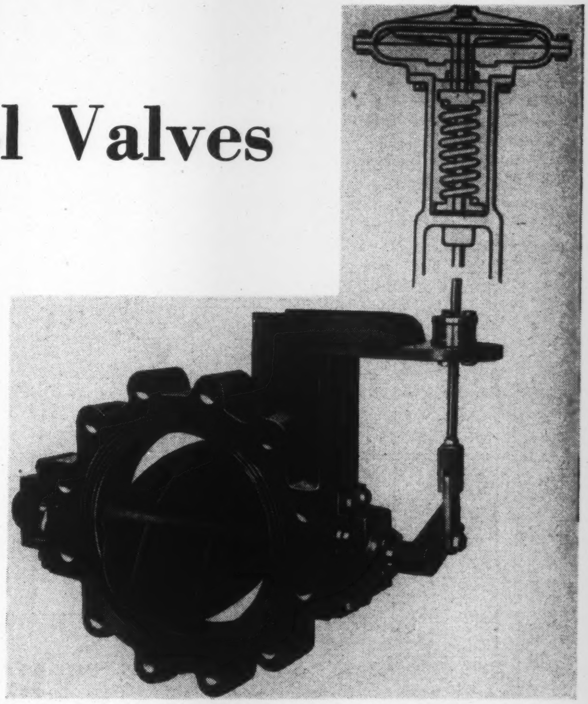
Toxic substances are extremely troublesome pollutants because of their immediate effect on stream life. Unfortunately, our knowledge of maximum tolerances for these agents is limited because of the great variation among species, but certain ions create adverse effects in very low

*Continued on page* 1748

# Butterfly Control Valves

By CHARLES A. DALLY
Continental Equipment Co.

**Operation of butterfly valves is clearly understood from examination of the unbalanced and static torques. Selection and sizing involves consideration of the torques, the system characteristics, valve operators, and valve flow characteristics.**



BUTTERFLY control valves offer four distinct economies over other types of valves—economy of (1) space required for installation, (2) first cost, particularly in large sizes, (3) pressure, and (4) maintenance when handling dirty fluids or fluids with suspended solids because the valve is self-cleaning under most conditions. However, the process engineer must know the valve's operating characteristics, design and application limitations, and potential flexibility in order to evaluate each manufacturer's product and also to present his problem to the manufacturers in the necessary detail that will command their best recommendations.

Although butterfly valves have been used for many years as control valves in services ranging from low-pressure combustion applications to high-pressure hydroelectric-dam installations, there has been little technical information available. Several publications are available covering the theoretical characteristics of butterfly valves—for example, ASME Paper 46-A-39 "Characteristic Coefficients of Butterfly Valves," which compares test data from several sources. This article is a practical evaluation of this theoretical test data (obtained under controlled laboratory conditions) as applied to valves in commercial systems.

## OPERATING CHARACTERISTICS

The butterfly valve is not a balanced valve. The drop in static pressure drop across the disk and the impact of the fluid during flow produce a thrust load on the disk, tending to carry it downstream. The thrust load produces two torques—unbalanced torque and static torque.

### *Unbalanced Torque*

The thrust load is not evenly distributed on the disk except at the closed (0 degree) and full-open (90 degree) positions of the disk. At all intermediate positions the thrust load on the wing of the disk turned toward the upstream side of the valve is greater than that on the wing turned downstream. Thus, if the disk is supported on a diameter by a shaft, this unbalanced loading produces a torque tending to *close* the valve. This torque, which is referred to as the "unbalanced" or "hydraulic" torque, is a function of the disk position and is directly proportional to both the pressure drop across the valve and the cube of the disk diameter:

$$\textit{Unbalanced torque} = G \times \textit{pressure drop} \times \textit{dia.}^3$$

where $G$ is the unbalanced-torque coefficient obtained by test for static-pressure drops measured by pipe taps. The unbalanced torque is *not* the total torque required to operate the valve; static torque must be considered also.

### *Static Torque*

The trust load on a butterfly disk produces a reaction in the bearings supporting the shaft, resulting in a frictional force which resists rotation of the shaft in *either* direction. As the thrust load varies with the pressure differential across the valve, a fixed allowance for stem friction cannot be made for a butterfly valve, as is possible with plug-type diaphragm-motor valves.

The torque required to overcome friction in butterfly valves, or static torque, is directly proportional to the thrust load, the diameter of the valve shaft, and the coefficient of friction between the bearing and the shaft materials. As the thrust varies with the disk position, the static-torque equation may be written as:

$$\textit{Static torque} = (f)\ (J)\ (\tfrac{1}{2}\ \textit{shaft dia.})\ (\textit{press. drop})\ (\textit{area disk})$$

where $f$ is the coefficient of friction for the bearing and $J$ is the thrust factor found by test for static-pressure drops measured by pipe taps.

As the unbalanced torque tends to close the valve and the static torque resists movement in either direction, the torque that must be applied to the valve shaft by the drive mechanism to *open* a butterfly valve must equal the ***sum*** of the two torques; to *close* the valve the torque must equal the *difference* between the torques—and its direction depends on the disk position.

Fig. 1 shows the operating characteristics for a 10-inch-diameter valve of a standard design with a pressure drop of 1 psi. at all angles of opening. The unbalanced torque is zero at the closed position of the valve, reaches a maximum at about 80 degrees open, and becomes zero again when the valve is fully opened. The difference between the curve of "Torque to Open" and the curve of "Unbalanced Torque" is the frictional torque, which increases as the valve is

---

**Presented at the Conference "Instrumentation for the Iron & Steel Industry," April, 1952, Pittsburgh, Pa.**

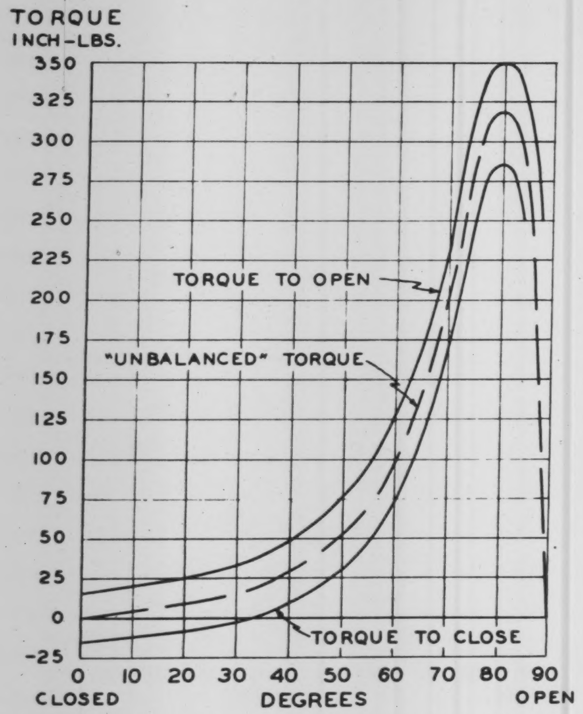


**Fig. 1. Torque characteristics of a 10-inch butterfly valve with constant 1-psi. pressure drop across valve.**

opened; however, in the region from 60 degrees to 80 degrees open the unbalanced torque is much larger than the static torque.

Several factors can cause actual operating curves to deviate from those in Fig. 1. Disk design has been found to have no effect on the magnitude of the torque, but it can change the angle at which the maximum torque occurs. For a constant pressure drop the maximum value can occur anywhere from an angular opening of 85 degrees (for a thin plate disk suitable for low pressure-differentials) to 60 degrees (for a disk with a maximum thickness equal to 25 percent of its diameter, capable of withstanding high pressure-differentials).

The operating torque in the open position decreases if the ratio of the upstream to downstream pressures is high, producing cavitation in liquids or flow rates approaching sonic velocity in gases. Fittings adjacent to either the upstream or downstream side of the valve produce unpredictable variations in the operating torque. When a valve is installed at the end of a pipe with a free discharge, the operating torque during flow is less than that required when it is in a pipe run. Static torque, of course, depends on valve bearings, the lubricating properties of the fluid being handled, the type of packing used to seal the shaft, and the packing-gland pressure required to seal the line pressure. To compensate for these factors, the manufacturer can make suitable corrections to the theoretical operating torque to determine the actual operating torque for a given valve application. As many factors affect the operating torque, published values of operating torque for butterfly valves can be used only if the basis for the data is known.

*System Characteristics*

The most important factor affecting the operating torque is the pressure-drop characteristic of the system in which the valve is installed. The curves in Fig. 1 are based on a constant pressure-differential across the valve at all positions of the disk, which is an unusual condition, although it can occur in certain installations. To control flow or pressure, the valve normally produces a greater pressure drop as the flow is decreased in order to compensate for the decrease in pressure loss caused by piping and other elements in the system whose resistance is a function of the velocity of the fluid.

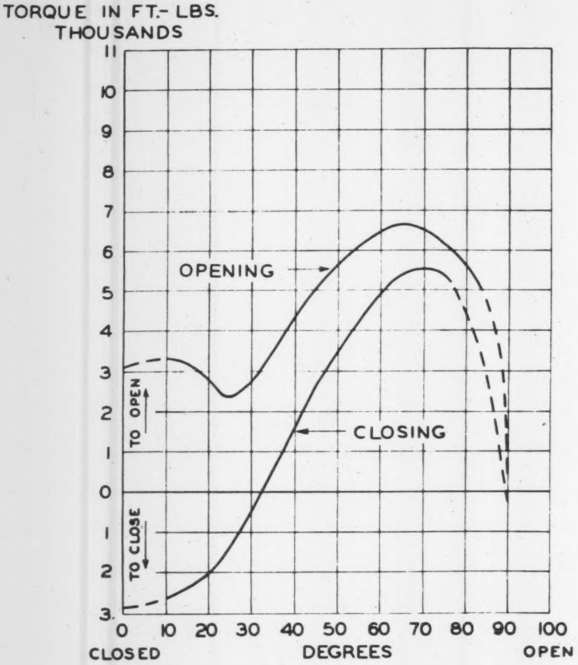


**Fig. 2. Operating torques of a 24-inch valve controlling water flow.**

To calculate the operating torque under such conditions it is necessary to know the pressure drop that the valve must produce in the system at several flow rates from minimum to maximum flow. With this information the required valve openings for each combination of pressure drop and flow can be determined from a butterfly-valve sizing chart or rule. Then, using torque curves for unit pressure drop (similar to those in Fig. 1 but for the valve size and construction under consideration) the operating torque is found by multiplying the unit torque value at a given angle by the corresponding pressure drop.

The curves from such a calculation are shown in Fig. 2, which were redrawn from a report describing tests conducted by the Pacific Gas and Electric Company on a valve at Spaulding Dam. The operating torque was measured on a 24-inch valve mounted on the end of a pipe and subjected to a pressure differential of 96.5 psi. when closed, which decreased to 64.5 psi. at an angular opening of 83 degrees with a flow of 90,000 gpm. of water.

From a comparison of Fig. 1 and Fig. 2 one can draw several conclusions regarding the operating characteristics of butterfly valves. First, the maximum operating torque may not always be required at the position of maximum flow, and seldom at the position of the maximum value on the unit torque curves. For the installation of Fig. 2, the maximum operating torque occurred at approximately 65 degrees open; and it is evident that as the ratio of the pressure differential (across the valve) when closed to the differential at maximum flow increases, the position of the maximum operating torque required occurs nearer to, or perhaps even at, the closed position of the valve. Second, the curve of "Opening" torque in Fig. 2 shows that the torque required to operate the valve does not increase or decrease uniformly throughout the full travel of the valve, but may be erratic—decreasing and then increasing. Finally, one finds that from closed to approximately 35 degrees open the direction in which the operating torque is applied must be reversed to change the direction of movement from opening to closing; whereas at positions beyond 35 degrees the operating torque is applied only in the opening direction.

Later it will be pointed out that it is normal practice to restrict butterfly control valves to a maximum opening of

60 degrees. The reason for this sometimes is given that it is done to avoid operating the valve in the region of torque reversal near 80 degrees angular opening. Examination of figures 1 and 2 fails to confirm this statement. As the curve of "Torque to Open" lies above the zero axis in both figures, the operating torque must always be applied in the opening direction to open the valve. Beyond the maximum value, at whatever angle of opening it may occur, the torque does not reverse but simply decreases in magnitude. The actual point of torque reversal frequently may occur near 30-degree-open position when closing the valve. At angles of opening greater than this the unbalanced torque tending to close the valve is greater than the static torque resisting movement. Thus a slight decrease in the operating torque applied in the opening direction can cause the valve to close under its own action to the desired opening. As the unbalanced and static torques are equal at 30 degrees, the valve will remain at rest at this point with no operating torque applied to its shaft. To close the valve from this point the operating torque must be applied in the closing direction to overcome the friction resisting rotation of the valve shaft.

### *Selection and Sizing*

The data required to determine the valve torque at all rates of flow for a given process is normally not readily available and involves considerable engineering study to develop. But when it is available it should be utilized to determine accurately the maximum operating torque and the opening at which it occurs so that the selection of valve design and motor unit can be based on this information. As this information is not available for most applications, it is common practice to base the valve and motor engineering on four factors which can usually be determined —(1) the maximum pressure-differential across the valve when closed, (2) the maximum pressure-differential across the valve at the closed position at such times that movement of the valve will be required, which may differ from the first condition, (3) the minimum flow to be controlled and the corresponding pressure drop that the valve must produce, and (4) the maximum flow and the corresponding pressure drop. By applying service and experience factors to this minimum service data, the maximum operating torque can be anticipated in the selection of equipment best suited for a given application.

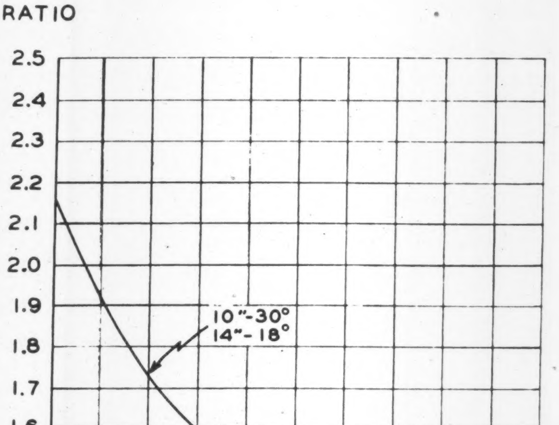


**Fig. 3. Ratio of torque required to operate a 14-inch valve to that required to operate a 10-inch valve with same flow at same pressure drop.**

As both static torque and unbalanced torque are functions of the valve diameter, proper valve sizing is important to economy because of its effect on the size of the operating device. Fig. 3 shows the relation between the torques required to operate a 14-inch and a 10-inch valve under the same service condition—that is, with equal flows at equal pressure drops. As illustrated, when closed against the same pressure differential the 14-inch valve requires a motor with 2:15 times the torque capacity of that required by the 10-inch valve. To pass 20 percent of a given maximum flow with equal pressure drops, a 14-inch valve must be open only 18 degrees as compared to 30 degrees for a 10-inch valve; however, its operating torque is shown to be 1.74 times that of the 10-inch valve. Likewise, at 100 percent of flow a 14-inch valve requires 1.32 times the operating torque of a 10-inch valve, although its disk need be only 48 degrees open as compared to 60 degrees for the 10-inch valve. Thus, regardless of the fact that the required angular opening is less in the larger valve, the size of the operating device is affected by valve size. The use of a motor that might be used if the valve were correctly sized may even be precluded by incorrect valve sizing.

## VALVE OPERATORS

Any of the numerous types of diaphragm, cylinder, or electric drives available can be used to actuate a butterfly valve. The most economical-size motor is used that will operate the valve satisfactorily under the specified service conditions. The magnitude of the required operating torque often precludes the use of a particular drive or motor. For example, the use of a spring-type diaphragm motor is often denied on larger valves operating under high differentials because the spring cannot be sufficiently precompressed to cause the valve to fail open or closed as required. If a springless-type motor or a cylinder operator is required, the valve action in the event of operating medium failure may be of concern. The curves in figures 1 and 2 indicate that if the valve is opened to an angle greater than 30 degrees at the time of such a failure, it would close to 30

*Continued on page* 1761

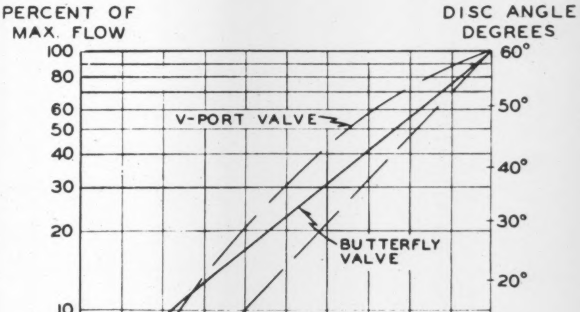


**Fig. 4. Characteristic curve of butterfly valve (with max. valve opening of 60 degrees) compared with that of a V-port valve and an equal-percentage valve.**

# Inspection and Measurement by ULTRASONICS

By R. H. FRANK
Jones & Laughlin Steel Corp.

**Ultrasonic inspection of forgings, castings, weldments, pipe, and tubing is growing. Automatic equipment is becoming available. Operational technique and data interpretation are important factors.**

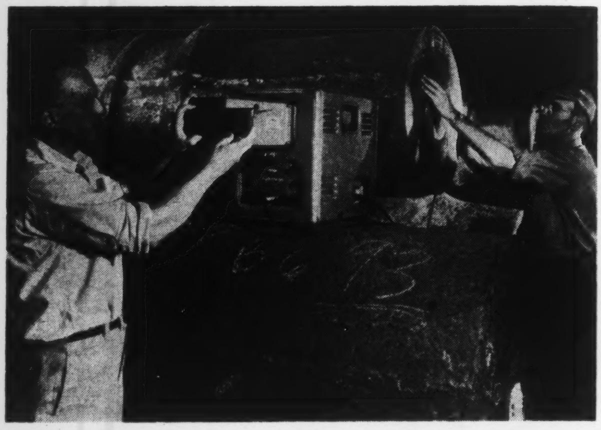


Fig. 1. "Reflectoscope."

ULTRASONIC* pulses of energy are now being used widely to reveal internal flaws in castings, forgings, and other metallic objects, and to measure the thicknesses of metallic objects that can not be "miked." The pulses of energy are transmitted through the object and are reflected by flaws or boundaries in the object. As the speed of motion of the pulse through the object is known, the time interval between the instant of pulse transmission and the instant of echo return is a measure of distance to flaw or boundary. The technique is similar to radar, except that pulses of ultrasonic energy are used rather than pulses of radio-frequency energy. The advantage of using ultrasonic energy is that its velocity in metals is inches per second, whereas r-f. energy propagates at velocities of miles per second. Thus the former is easier to use for the relatively small distances involved in detecting flaws or measuring thicknesses of metallic structures.

### "REFLECTOSCOPE"

Fig. 1 shows a "Reflectoscope," which produces the pulses and displays the echoes on the oscilloscope screen. The *pulse* is triggered 60 times a second. The time duration of the pulse can be varied by a control marked "Pulse Length."

The oscilloscope sweep, or horizontal line, is a dot that sweeps across the oscilloscope at constant velocity, 60 times each second. It's length on the screen can be varied by a control marked "Sweep Length."

*Markers* may be superimposed on the sweep to divide it into equal increments of time or distance. The number of such increments can be varied by the "Marker" control.

*The amplifier* magnifies the minute echo signal. The degree of amplification is varied by the control marked "Sensitivity."

### TRANSDUCER

The heart of an ultrasonic system is the method of transforming electrical pulses into mechanical vibrations, and transforming the mechanical vibrations back into electrical pulses. Piezoelectric crystals have the ability to do these two things; the most common crystal used is quartz.

When an alternating electrical field is applied across a piece of quartz, it's thickness varies at the same frequency as that of the applied field. Conversely, when a vibratory pressure wave is exerted on the face of the quartz, the crystal generates a small voltage of the same frequency as the applied vibration. The quartz assembly is called a transducer, or searching unit.

The vibrating movement of the quartz is infinitesimal; it often is described as acceleration without motion. To transmit such small energy into a material it is necessary to use an incompressible couplant between the quartz face and the material surface; oil is used most commonly.

### BEAM DIVERGENCE

Fig. 2 shows how the beam of sound waves diverges while traveling through steel. Note that the beam divergence de-

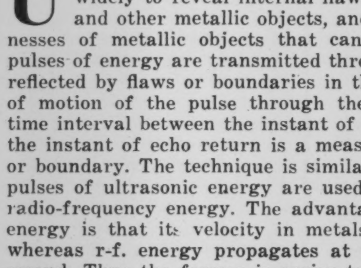


Fig. 2. Beam divergence, showing effect of wavelength and crystal diameter.

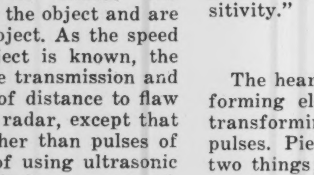
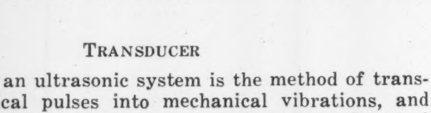


Fig. 3. Longitudinal sound striking surface at angle of 29 degrees.


QUARTZ
LUCITE
Φ1
Φ1
V1
V2
Φ2
STEEL
SIN Φ1 / SIN Φ1 = V1 (LUCITE) / V2 (STEEL)
LONG. V1 (LUCITE) = 105,000
LONG. V2 (STEEL) = 229,000
TRANS. V2 (STEEL) = 126,000
SURF. V2 (STEEL) = 115,000

| Φ1<br>WEDGE ANGLES | Φ2<br>STEEL ANGLES | DOMINANT MODE OF VIBRATION |
|---|---|---|
| 0–15 | 0–35° | LONGITUDINAL |
| 27–55° | 35°–80° | TRANSVERSE |
| 55—UP | 90° | SURFACE |

Fig. 4. Refraction, showing why a wavefront changes angle upon entering a medium in which it has different velocity.

---

*Ultrasonic refers to "sonic" compressional-type (longitudinal) waves with frequencies above the audible—that is, above 20 kc.

Presented at the Conference "Instrumentation for the Iron & Steel Industry," April, 1952, Pittsburgh, Pa.

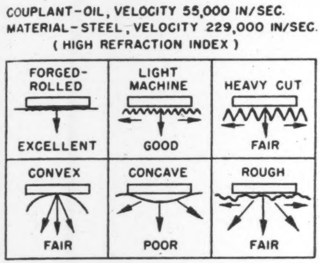

COUPLANT-OIL, VELOCITY 55,000 IN/SEC.
MATERIAL-STEEL, VELOCITY 229,000 IN/SEC.
( HIGH REFRACTION INDEX )
FORGED-ROLLED
EXCELLENT
LIGHT MACHINE
GOOD
HEAVY CUT
FAIR
CONVEX
FAIR
CONCAVE
POOR
ROUGH
FAIR

Fig. 5. Six typical surfaces encountered in ultrasonic testing.

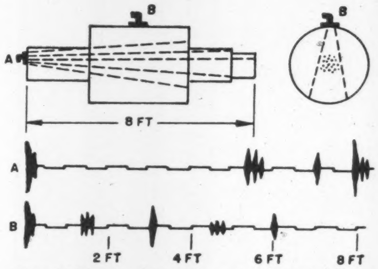

B
A
B
8 FT
A
B
2 FT
4 FT
6 FT
8 FT

Fig. 6. Sound patterns in a forged rotor when searching unit is at positions A and B.

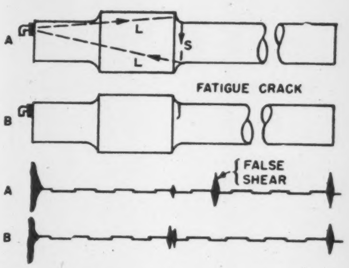

A
L
S
L
FATIGUE CRACK
B
FALSE SHEAR
A
B

Fig. 7. Test of a crane shaft, showing false shear.

pends on both frequency and quartz diameter. Divergence decreases as frequency increases and as the quartz diameter increases. A directive beam is desired for accurate searching of flaws. Therefore as high a frequency and as large a diameter of quartz should be used as is consistent with practical and loss factors. In ultrasonic testing, beam divergence usually is expressed in inches per foot, rather than angular degrees.

### WAVELENGTH FACTORS

Sound waves, like other waves, are described in terms of velocity, frequency, and wavelength. The velocity equals the frequency times the wavelength. As the velocity of sound in a given material is essentially constant, the wavelength decreases as frequency increases. At ½ Mc. the wavelength is about 0.6 inch; at 5 Mc. the wavelength is about 0.06 inch.

Just as a large ball will bounce over objects less than half it's diameter, a sound wave of long wavelength bounces over and does not reveal small flaws. Similarly, just as a ball of small diameter will not roll very far, a sound wave of short wavelength has high internal friction losses. In practical testing, therefore, frequency selection is a compromise between sensitivity desired and sound penetration required.

In addition to sensitivity and penetration, wavelength also determines the pulse length. If a pulse consists of 5 cycles of energy, the length of the pulse is 5 times the wavelength. Low frequencies, therefore, have longer pulse length, whereas high frequencies have shorter pulse length. A short pulse length is desired.

### SOUND REFLECTION

The factor which determines sound reflection at a boundary between two media is the product of the density of each medium and the velocity of sound in that medium. This product is called the *acoustic impedance*. If sound traveling in steel encounters an abrupt change in medium, the percent of energy reflected is determined by the acoustic impedance of the steel ($Z_1$) as compared to the acoustic impedance of the other medium ($Z_2$), according to the following relation:

$$\%\ Reflection = [(Z_1 - Z_2)/(Z_1 + Z_2)]^2$$

### MODES OF VIBRATION

The velocity of a sound wave traveling through a material depends on the mode of vibration. The mode may be transformed and a different velocity assumed when longitudinal sound strikes a surface at an angle (Fig. 3). Depending upon the angle, some or all of the incident waves is converted into shear waves whose particle movement is transverse to the direction of wave travel. Shear waves have a velocity of approximately half that of longitudinal waves. The angle of 29 degrees shown in Fig. 3 is significant because when a longitudinal wave strikes a surface at 29 degrees in steel, two things occur: (1) The resultant shear wave travels at 90 degrees to the incident wave, and (2) 98 percent of the incident energy is converted into shear.

At an angle of 61 degrees, 50 percent of the energy is converted into shear, and 50 percent of the energy remains longitudinal. At angles greater than 61 degrees, the percent of energy converted into shear drops off sharply. At angles less than 61 degrees, the percent of energy converted into shear increases sharply.

If the transducer is placed on the sharp edge of the steel (Fig. 3), a third mode of vibration, or *surface wave*, can be generated. This wave travels along the surface of the steel at a speed approximately half that of the longitudinal wave.

### REFRACTION

Refraction is used to change the angle of sound entrance into steel. Fig. 4 illustrates why refraction occurs when a wave passes from one medium to another in which it has different velocity. The speed of sound in lucite is approximately half the speed of longitudinal sound in steel. When the leading edge of the sound wavefront traveling through the lucite reaches the steel interface, it doubles in speed upon entering the steel and, therefore, travels twice as far in a given time as it does in the lucite. Thus in the time required for the entire wavefront to pass into the steel, the bottom end of the wavefront is far advanced and the wavefront travels at a different angle. This phenomenon is called refraction. Fig. 3 shows the refraction formula and various velocities for computing the refracted angles in the steel as the incident angle is changed.

### SURFACE EFFECTS

As ultrasonic test methods depend upon intimate contact and coupling of the quartz to the material under test, surface conditions are of prime importance. Fig. 5 shows six typical surfaces. The ratings of excellent, good, fair, and poor are based on the amount of sound energy transmitted

*Continued on page 1752*

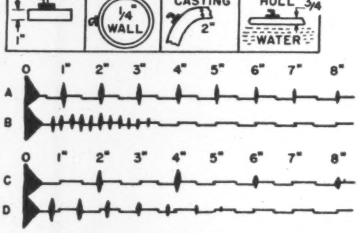

A
B
C
D
REFERENCE
PIPE WALL
CORED CASTING
SHIP HULL
1"
1/4" WALL
2"
3/4"
WATER
0
1"
2"
3"
4"
5"
6"
7"
8"
A
B
0
1"
2"
3"
4"
5"
6"
7"
8"
C
D

Fig. 8. Reflection techniques for thickness measurements.

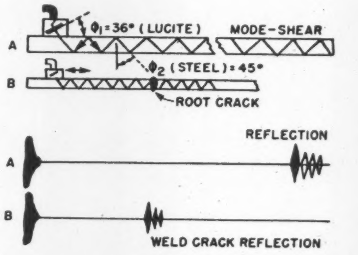

φ1 = 36° (LUCITE)
MODE-SHEAR
A
B
φ2 (STEEL) = 45°
ROOT CRACK
REFLECTION
A
B
WELD CRACK REFLECTION

Fig. 9. Test methods and sound patterns for testing plate and weldments by use of shear waves, or angle testing.

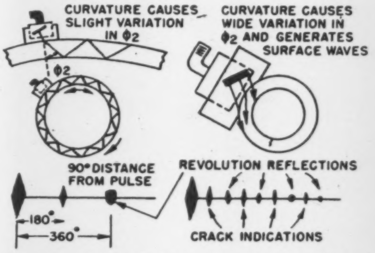

CURVATURE CAUSES SLIGHT VARIATION IN φ2
CURVATURE CAUSES WIDE VARIATION IN φ2 AND GENERATES SURFACE WAVES
φ2
90° DISTANCE FROM PULSE
REVOLUTION REFLECTIONS
180°
360°
CRACK INDICATIONS

Fig. 10. Angle-testing technique for pipe and tubing.

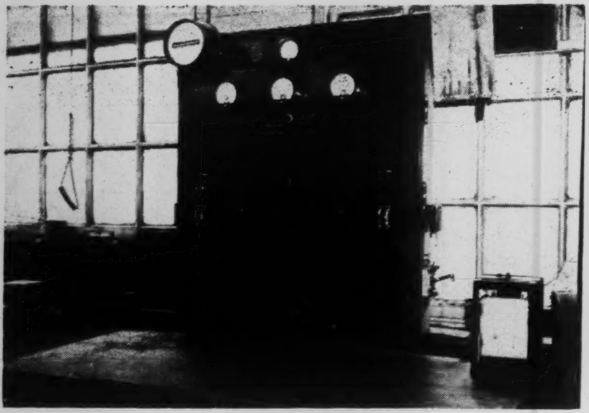


Fig. 1. Electrical test board with a-c. and d-c. outputs.

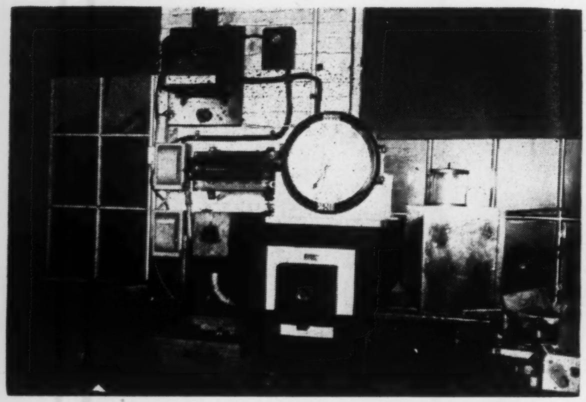


Fig. 2. Laboratory test furnace for testing thermocouples.

# Steel Plant Instrument Department Problems—

# PERSONNEL TRAINING an

GROWTH of instrumentation and automatic control in industrial plants has resulted in a corresponding increase of personnel in instrument departments. Management is aware that proper instrumentation can be a determining factor in obtaining low fuel costs, high efficiency, and maximum profit. For this and other reasons the demand for adequate instrument maintenance has become more pronounced. The rising cost of labor and material now demands economy of operations and close adherence to specifications, which in turn demands an efficient and capable instrument department.

### Quarters and Facilities

Certain facilities are necessary to keep a well-balanced precision-conscious department functioning with a minimum of outage of operating equipment. The department supervisor first must determine the type of facilities that can be serviced, repaired and calibrated in the shop or in the field. He also must determine the number and types of approved test apparatus required.

Consideration should be given also to suitable shop quarters and facilities. As instrument work is close and sometimes tedious, a well designed and equipped shop will promote interest and accuracy among the personnel. The shop should include (1) office, (2) tool room, (3) electronic and electrical, (4) storage & spare parts, (5) heavy work (valves, welding, etc.), (6) flowmeter, (7) cleaning, and (8) clocks, special devices, & experimental projects.

The *storage and spare parts area* should accommodate all instruments and parts which may be in stock at a given time. Crowded storage shelves result in loss of time and occasional damage to materials. All cabinets and shelves should be plainly marked so that parts and instruments can be located quickly.

The *electronic, electrical, clock and specialty areas* should be clean and well lighted, with necessary electrical outlets available to all benches in these areas. They should be located where there is little or no vibration; reading a mirror-type galvanometer when it is fluctuating because of vibration is an impossibility. The floor space required is determined by the nature and number of instruments or control units to be serviced, and by the test equipment required.

### Equipment

Test equipment for the shop and instrument men ranges from single-tube water manometers to cathode-ray oscillograph. All shops should be supplied with (1) utilities such as steam, air, water, and electricity, (2) racks for mounting instruments under test, (3) power tools, (4) work tables, (5) card files for instrument data, and (6) a complete library of descriptive and technical bulletins, catalogs, and instruction material.

Fig. 1 shows an electrical test board in the laboratory, designed to test any type of electrical instrument. The switches and terminals can be arranged to supply a-c. or d-c. voltage, amperes, millivolts, and power factor.

Fig. 2 shows a laboratory test furnace, having a range to 2400 deg. F., that is used for testing base- and noble-metal thermocouples. A semi-precision potentiometer is used for this test, with a switching arrangement for transferring the output of the standard thermocouple to the output of the service thermocouple.

Fig. 3 shows the test equipment required for calibrating optical pyrometers.

Fig. 4 shows the test equipment used for calibration of positive displacement meters.

Figs. 5 and 6 illustrate a test panel used for calibration of hydraulic controls. We believe this is a new development. All new and reconditioned control units can be subjected to a test run under simulated service conditions; accurate calibration adjustments can be made.

A meter laboratory should have several *standard thermocouples*, each with a Bureau of Standards' certificate giv-

---

Presented at the Conference "Instrumentation for the Iron & Steel Industry," April, 1952, Pittsburgh, Pa.

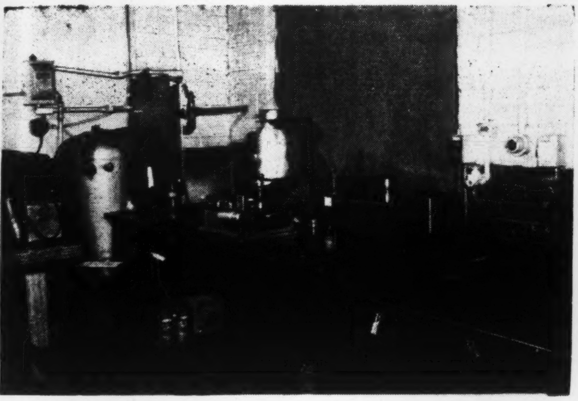


Fig. 3. Test equipment for calibrating optical pyrometers.

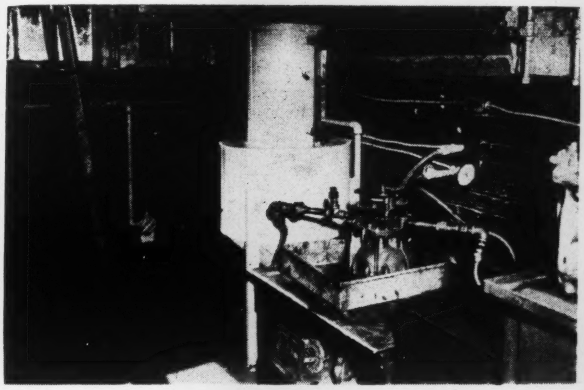


Fig. 4. Test equipment for calibrating positive displacement meters.

By J. H. CUTHBERT
U. S. Steel Co.

# MAINTENANCE FACILITIES

ing the accuracy of the thermocouple throughout its range. These standards should be kept under lock and used only for check of sub-standards.

Many plants fabricate their own thermocouples. The thermocouple wire, if purchased from a reputable supplier, should test within Bureau of Standards' tolerances when fabricated into a thermocouple. For testing these thermocouples a secondary standard is used with a portable potentiometer. As thermocouples are affected by atmospheric conditions, temperature, and vibration, no one can say how long a thermocouple will hold its original characteristics. Periodic checking is the only real safeguard.

Care and attention to *primary standards* is of utmost importance. For example, the *portable potentiometer*, an instrument regarded as the most accurate portable means of measuring temperature with a thermocouple or for checking recording-type instruments, must be treated with care. These instruments are affected by dirt and vibration; the batteries must be changed and slidewires cleaned. They should be checked by comparison with a precision potentiometer at frequent intervals. *Dead-weight testers* can be used for calibrating standard gages. A complete set of *standard indicating portable meters* should be available for checking field sub-standard electric meters. All possible ranges of *water manometers* should be included in the meter laboratory equipment; some should be designated as standards and maintained as such for checking the manometers used by field men. Quite often, if the glass tube of a field unit is broken, a tube of the same bore and inside diameter is unavailable; too frequently a new glass tube is placed into a unit with no thought given to tube size. When this occurs the field unit is not in calibration until the scale is changed.

*Electronic instruments* are becoming very common today, but special equipment is necessary when repairs are required. A *volt-ohm-milliammeter* is essential. A *tube tester* is recommended for shop use because all electronic tubes, new and old, should be tested. A *capacitance bridge* is useful for testing capacitors; as is a *cathode-ray oscilloscope* for testing electronic amplifiers. A chart can be made of various waveforms taken from the screen of the oscilloscope by introducing different faults into an amplifier; this helps in locating amplifier troubles quickly.

A *portable flowmeter* is helpful to the instrument man in any large plant. It can be used for a few days in a location where there is no permanent meter, or in parallel with a service meter for test purposes. It should have a set of range tubes covering most of the ranges in plant use.

Certain test equipment may be permanently located in the field. Fig. 7 illustrates thermocouple maintenance in an open-hearth shop. To facilitate the frequent testing of platinum-rhodium thermocouples, a test furnace and a galvanometer provide a practical on-the-job test.

The manner in which test apparatus is applied is important. It must be convenient to use and the instrument technician must know how to use it properly. Test equipment must have good care and be used with discretion. Complete instructions should be accessible to the employee using any apparatus.

### INSTRUMENT MECHANIC TRAINING

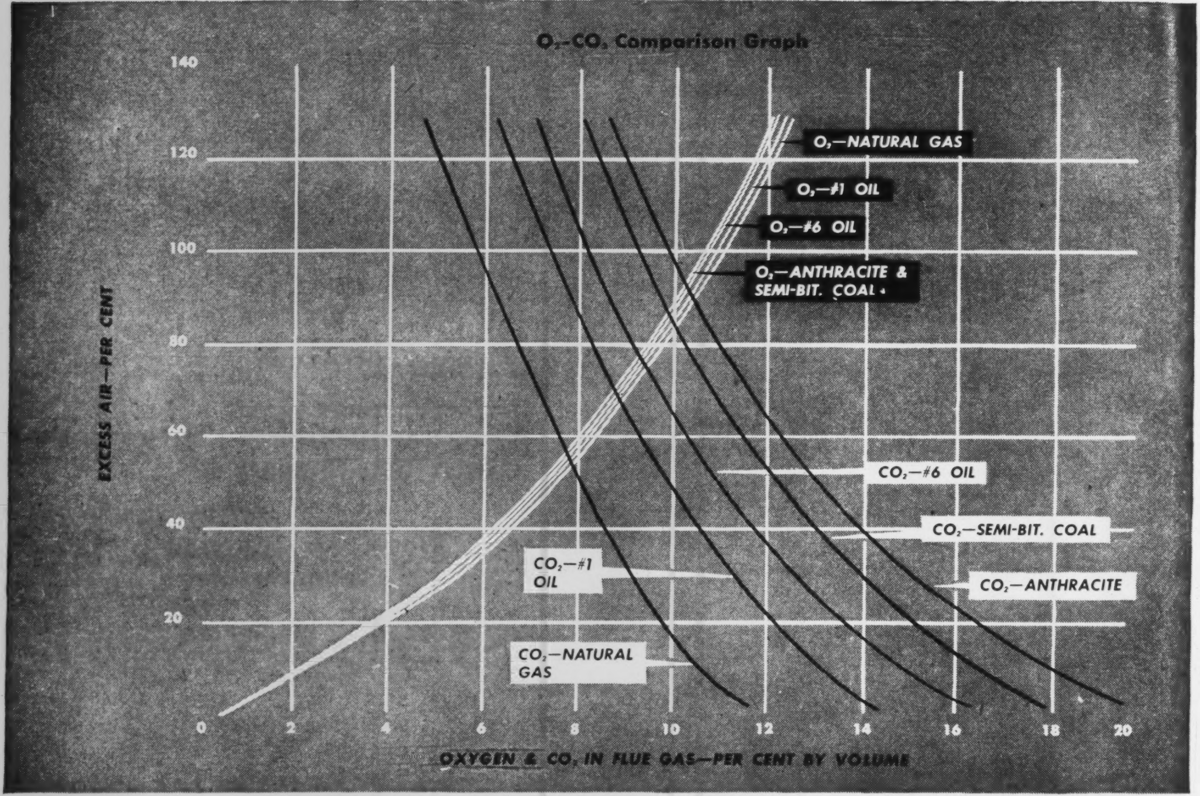
The many advances in instrumentation require training sessions both in principles and maintenance so that the instrument man can meet all requirements of his job.

Training programs for instrument men are somewhat controversial. For several years I have been connected with training courses offered by the Instrument Society of America, the U. S. Steel Company, and by Training Institutes. So many excellent ideas have been brought out that it is difficult to decide on one definite course of study.

The purpose of a training program is to develop a complement of skilled workmen adequate to maintain plant facilities and equipment at a high degree of efficiency. To accomplish this the program should (1) develop skill in

*Continued on page 1758*

# How to burn Multiple Fuels efficiently



***Oxygen and Oxygen alone gives you an undistorted picture of the amount of excess air present.***

When switching from one fuel to another or burning more than one fuel at the same time, you can realize large savings with a continuous indication of Oxygen content in your flue gas—because Oxygen and Oxygen alone gives you an undistorted picture of the amount of excess air present.

This fact is borne out by the graph showing the relationship of excess air to $CO_2$ and $O_2$ in the flue gas of five common fuels. While the $O_2$ curves nearly coincide (especially in the important 30% excess air range) the $CO_2$ curves diverge widely.

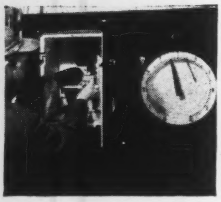
### Large Savings Possible

This deviation was costing a medium sized refinery in Michigan $35-40 per day in boiler room fuel costs. Burning a combination of oil and gas they found that a combustion control system to handle their multiple fuel firing conditions would cost more than their small boilers.

They purchased a Hays Magno-Therm Oxygen Recorder, and immediately found that their boiler operation was so inefficient that the pen would not stay on the 0-10% chart. However, by operating with reference to the $O_2$ recorder they were able to reduce fuel costs enough *to pay for the instrument in 40 days,*

With the Hays Magno-Therm Oxygen Recorder you get:

**Continuous, highly accurate indication and recording.**
**Complete compensation for temperature and pressure effects.**
**Freedom from chemicals or hazardous fuel burning in the analyzing process.**
**Swift, sure electronic operation.**



If you are facing the problem of multiple fuel combustion, you will want a detailed copy of this $O_2$-$CO_2$ Comparison Graph as well as Hays Bulletin 50-829—describing the Magno-Therm Oxygen Recorder. Write for this free information.

**THE HAYS CORPORATION**
***MICHIGAN CITY 21, INDIANA***

**Automatic Combustion Control • Boiler Panels • Hays-Penn Flowmeters**
**Veriflow Meters and Veritrol • Gas Analyzers • Draft Gages**
**Combustion Test Sets • $CO_2$ Recorders • Electronic Oxygen Recorders**

# INSTRUMENT SOCIETY of AMERICA Journal

National Office: 1319 Allegheny Avenue, Pittsburgh 33, Pennsylvania

Vol. 8 December 1952 No. 12

**EXECUTIVE BOARD**

*President*
A. O. BECKMAN

*First Vice-President*
W. A. WILDHACK

*Vice-President*
D. M. BOYD, JR.

*Vice-President*
N. L. ISENHOUR

*Vice-President*
R. T. SHEEN

*Secretary*
PORTER ART

*Treasurer*
G. R. FEELEY

*Past President*
J. B. MCMAHON

## CONTENTS

Manager's page ........ 1726

Employment Service ........ 1727

Sections Data ........ 1726

Operation of a Semi-continuous Process Using the Kinegraphic Control Board ........ 1727
By John E. Read and John Johnston Jr.

Improved Flow Control With Long Lines ........ 1733
By W. E. Vannah and A. R. Catheron

Putting the Instrument To Work ........ 1737
By H. A. Hulsberg

# THE MANAGER'S PAGE

### Percy V. Jones, Jr.

Every member of every Section can play a personal part in building the Society by sending to the National Office names of prospective members on the return post card sent to you with your copy of "YOU AND THE ISA".

Early returns from this mailing have been most encouraging, but many have not yet responded. If you have not returned your card, do so now. It is easy to do your "bit".

The September issue of the New York Integrator, the organ of the New York Section of the Society, contained the following message which should be heeded by all members:

Are YOU Doing Your Bit

The Instrument Society of America is rapidly becoming the Voice of the Instrument Industry. Through its technical committee it is helping set up standards both as to design and performance. Through its educational committees, methods of training are being established. Its National Annual Instrument Show brings into one location for all to study the latest developments in Instrumentation and Control.

The local meetings offer opportunities for you to get acquainted with men in your own industry; to hear interesting papers, to express your opinion for the good of your profession. The benefit you receive will be in proportion to the effort you put in. If you would like to see your friends more often, invite them to join the Society.

This year we are going to send meeting notices to a number of men not members of the Society, with the hope that if they attend a few meetings, they will become enthused and want to share in both the work and the benefits of a member.

Will you help us? Send the names and addresses and company affiliation of all men you know who should be members of the ISA to the Chairman of the Membership Committee.

## Dr. Beckman to Serve on National Research Council

Porter Hart, incoming President of the Society, has named Dr. Arnold O. Beckman to serve as the ISA representative on the National Research Council. Dr. Beckman's appointment is for a three year term.

On April 16, 1952, the National Research Council invited the Instrument Society of America to become an affiliate. The ISA Executive Board accepted the invitation July 18, 1952.

## Section Secretaries, Meeting Data and Programs

**AKRON**
Russell F. Marquardt, 1782 Tonawanda Ave., Akron 5, Ohio. Tel: ST-6865
Fourth Tuesday, Meeting 8:15 P.M., U. of Akron, Ayer Hall, Rm. 212-B.
January 27, 1953 "Control Valves and Valve Positioners" by speaker from Fisher Governor Company.

**ALBUQUERQUE**
C. F. Cox, 209 Gen. Hodges, Rd. N. E., Albuquerque, N. M.
First Monday, Meeting at 8:00 P.M., Mitchell Hall, Univ. of New Mexico.

**ARUBA**
J. L. Lopez P. O. Box 208, c/o Lago Oil & Transport Co. Ltd., Aruba, N. W. I. Tel. 2087.
First Tuesday, 7:30 P. M., Engr's Club.

**ATLANTA**
M. Virgil Davis, 357 Sixth St., N.W. Atlanta, Ga. Tel. EM. 3642
Fourth Friday, Meeting 7:30 P.M., Electric Bldg., Georgia Power Co.

**BALTIMORE**
G. B. Greer, 681 East 36th St., Baltimore 18, Md. Tel: CHesapeake 6879
Second Friday, Meeting at 8:00 P.M., Engr's. Club of Baltimore.

**BATON ROUGE**
G. M. McCarroll, 1813 Edinburgh Ave., Baton Rouge 6, La.
Meeting monthly, L.S.U. Physics Bldg.

**BOSTON**
Stephen E. Lord, 60 Braintree Ave., Quincy 69, Mass. Tel: MA 9-1066
Fourth Wednesday, Dinner at 6:30 P. M., Meeting at 7:30 P. M., 99 Club, 99 State St.

**CALIFORNIA**
Gerald B. Miller Company, 1544 Highland Ave., Hollywood 28, Calif., Tel. Hollywood 9-6305
Second Wednesday, Dinner at 6:30 P. M. Meeting at 8:00 P. M.
January 7, 1953, Carolina Pines Restaurant, 7315 Melrose Ave., Los Angeles.

**CAROLINA PIEDMONT**
L. Frank Lawrence, Minneapolis-Honeywell Regulator Co., 2400 Wilkinson Blvd.. Charlotte, N. C., Tel: 5-4422
Second Friday, Dinner at 7:30 P.M., Meeting at 8:30 P.M. Cardinal Restaurant, Charlotte, N. C.

**CENTRAL ILLINOIS**
Thomas A. Carroll, 721 Hurlburt St., Peoria, Ill., Tel: 4-8909
Second Wednesday, Some dinner meetings at 6:30 P. M., Meeting at 7:30 P. M.

**CENTRAL INDIANA**
Norman Krone, 123 N. Grant Ave., Indianapolis, Ind. Tel: IRvington 5337
First Tuesday, Meeting at 7:30 P. M.

**CENTRAL NEW YORK**
H. G. Murray, 169 Durston Ave., Syracuse 6, N. Y. Tel: 9-9259
Third Monday, Dinner at 6:00 P. M., Meeting at 8:00 P. M.

**CENTRAL OHIO VALLEY**
J. C. Dilliner, 813 Winton Ave., Belpre, Ohio. Tel: Belpre 87596
First Tuesday, Dinner at 7:30 P. M., E.S.T., Hi-Way Grille, Rt. #2, about 3 miles south of St. Mary's, W. Va.

**CHARLESTON**
D. A. Cunningham, 5140 Washington Ave., S.E., Charleston, W. Va. Tel. 55403
First Monday, Dinner at 6:15 P.M., Meeting at 8:00 P.M., Kanawha Airport Terminal Bldg.

**CHICAGO**
Floyd E. Ertsman, Rm. 1420, Fisher Bldg., 343 S. Dearborn St., Chicago 4, Ill. Tel: WE 9-0686
First Monday, Dinner at 6:30 P. M., Meeting at 8:00 P.M.
January 5, 1953, Regular Dinner—Shoreland Hotel—Subject "Optical Gaging".

**CHINA LAKE**
Beuhring W. Pike, 606-A Essex Circle, China Lake, Calif. Tel: 77782
Third Thursday, Meeting at 8:00 P.M., Michelson Lab, USNOTS, Conference Room.

**CINCINNATI**
E. J. Geiser, 3666 Hubble Rd., Cincinnati 24, Ohio Tel. Ja. 5618.
First Monday, Dinner at 6:30 P. M., Meeting 8:00 P.M., Engineering Soc. of Cinn.

**CLEVELAND**
M. M. McMillen, Thompson Products, 2196 Clarkwood Ave., Cleveland, Ohio
Second Wednesday, Dinner at 6:30 P. M., Meeting at 8:00 P.M., Cleveland Eng'r. Society, 2136 E. 19th St.

**COLUMBUS**
Kenneth I. Lea, Battelle Institute, 505 King Ave., Columbus 1, Ohio Tel: UN-3191, Ext. 247.
Third Thursday, Meeting at 8:00 P.M., Battelle Auditorium

**CUMBERLAND**
Clyde Babst, 225 Cecelia St., Cumberland, Md. Tel: 583-W
Fourth Wednesday, Dinner at 6:30 P. M., Meeting at 8:00 P.M.
Christmas Party at the Cottage Inn.

**DENVER**
Karl F. Kent, Jr., 5030 Umatilla, Denver 11, Colo. No regularly scheduled meetings. Univ. of Denver, Science Bldg.—Campus

**DETROIT**
R. A. Hoxie, Basic Service Corp., 14016 Woodrow Wilson, Detroit 6, Mich., Tel: TO-88043
Third Wednesday, Meeting 8:00 P. M., Rackham Memorial Bldg., 100 Farnsworth, Detroit, Mich.

**EASTERN NEW YORK**
Robert W. Carter, Sterling-Winthrop Research Institute, Rensselaer, N. Y. Tel. Albany 5-6251 Ext. 262
First Tuesday, Meeting at 8:00 P.M., Siena College, Loudonville, N. Y. Optional Dinner at 6:00 P.M., Circle Inn, Lathams, N. Y.

**FOX RIVER VALLEY**
John R. Redgrave, 109 S. Appleton St., Appleton, Wis.

**GULF COAST**
Harold Placette, 2440 Neches Ave., Port Arthur, Texas
Last Tuesday, Meeting at 7:30 P. M., Orange County Courthouse, Orange, Texas.

**HOUSTON**
A. Costa, 714 East 17th St., Houston 8, Texas.
Last Monday, Meeting at 8:00 P.M., University of Houston Library Building.

**KANSAS CITY**
J. C. Brous, 8827 Maiden Lane, Kansas City 5, Mo. Tel: HI 8556
First Tuesday, Meeting at 7:30 P.M., U. of Kansas City, Science Bldg., Rm. 106.
January 6, 1953 "Stacked Controls and Their Application in the Process Industry", by R. E. Clarridge of Taylor Instrument Co.

**LAKE CHARLES**
A. T. Clinger, Columbia Southern Chemical Corp., P. O. Box 900, Lake Charles, La. Tel. 6-7522
First Wednesday after last Monday, Dinner and regular meetings at McNeese State College

**LOUISVILLE**
C. M. Bosworth, 5336 Westhall Ave., Louisville, Kentucky. Tel: FR 3494
First Monday, Meeting at 8:00 P.M., Seagram Auditorium.

**MONTREAL**
W. L. Toohey, Dominion Textiles Ltd., 1950 Sherbrooke St., West, Montreal, Quebec, Tel. Gl 5711
Last Monday of Month, Meeting 8:00 P.M., Mechanics Institute

**MUSCLE SHOALS**
Atherton Hastings, Tennessee Valley Authority, Div. of Chemical Engineering, Wilson Dam, Alabama. Tel: Sheffield 3160, Ext. 6238
First Thursday, Meeting 8:00 P.M., TVA Chemical Engineering Bldg.

**NEW JERSEY**
Eliot R. Hill, 1125 Kensington Ave., Plainfield, N. J.
First Tuesday, Meeting 8:00 P. M., Essex House Hotel, Newark, N. J.

**NEW ORLEANS**
W. H. Haney, 2927 Music St., N. O. 22, La.
No Regular Date, Meeting at 8:00 P.M.

**NEW YORK**
R. A. Hutcheon, 45-65 196th St., Flushing 58, N. Y., Tel: BAyside 9-5432
Third Monday, Dinner at 6:00 P. M., Meeting at 7:30 P. M., Midston House, 38th St. & Madison Ave.

**NIAGARA FRONTIER**
Duran L. Hagler, 214 E. Delavan Ave., Buffalo, N. Y., Tel: ELmwood 1258
Dinner at 6:00 P. M., Meeting at 8:00 P. M., N. Y. S. Technical Institute, 1685 Elmwood Ave., Buffalo, N. Y.

**NORTH TEXAS**
R. E. Byers, 6000 Lemmon Ave., Dallas 9.

**NORTHERN CALIFORNIA**
Robert L. Norman, 351 42 St., Richmond, Calif. Tel: BE 2-0901
Third Monday, Dinner 6:30 P. M., Meeting 8:00 P.M. Spengers Grotto, 1919 4th St., Berkeley.

**NORTHERN INDIANA**
M. J. Duzmal, 10504 Avenue "J", Chicago 17, Ill. Second Tuesday, Meeting at 8:00 P.M., Whiting Community Center, Whiting, Ind.

**OAK RIDGE**
George Ritscher, 113 Gorgas Lane, Oak Ridge, Tenn. Tel. 5-1084
**First Wednesday, Meeting at 7:30 P.M., Ridge Recreation Hall**
January 7, 1953 "Donald P. Eckman, Consultant for Conoflow Corporation will be guest speaker.

**ONTARIO**
**John W. Huether, 311 Southerland Dr., Leaside. Ontario, Canada. Tel: HU-7114**
Fourth Thursday, Meeting at 8:00 P.M. Friendship Hall, College St. United Church, Toronto

**PANHANDLE**
George W. Leggett, 1201½ W. 6th St., Amarillo, Texas. Third Tuesday each month. Either Amarillo or Borger, Texas.

**PERMIAN BASIN**
**J. B. Jenkins, 509 South Ave. "C," Kermit, Texas. Tel: 3220**
Second Tuesday, Meeting at 7:30 P. M., Gulf Oil Corp. Auditorium or Odessa College.

**PHILADELPHIA**
**R. A. Trenner, Energy Control Co. Rm. 306, 3147 N. Broad St., Philadelphia 32, Pa. Tel: SA 2-7900**
**Third Wednesday, Meeting at 8:00 P.M., Bellevue-Stratford Hotel.**

**PITTSBURGH**
Dr. A. H. Peterson, Mellon Institute, 5500 Fifth Ave., Pittsburgh 13, Pa. MAflower 1-1100
Fourth Monday, Dinner at 6:30 P.M., Meeting at 8:00 P.M., Roosevelt Hotel
January 26, 1953 "Electronics—Transitors" by Dr. E. A. Bell, Bell Laboratories

**PRESQUE ISLE**
Edwin P. Schuwerk, 445½ Halley St., L. P., Erie, Pa. Tel: 2-3349
Fourth Tuesday, Meeting at 8:00 P.M., G. E. Community Center, East Lake Rd., Erie, Pa.
January 27, 1953 "Application of Ultrasonics" by George Henry, General Electric Co., Schenectady, N. Y.

**RICHLAND**
J. R. Plee, 1309 Roberdeau, Richland, Wash. Tel: 5-8692
Second Wednesday, Meeting at 7:30 P. M., American Legion Hall

**ROCHESTER**
R. C. Schwartz, Jr., Foxboro Co., 1201 Granite Bldg., Rochester 4, N. Y. Tel: Hamilton 1468
Fourth Tuesday, Meeting at 8:00 P.M., Univ. of Rochester, Physics Lecture Hall
January 27, 1953, "Hydraulic Control as Applied to Speed Governing", by Woodward Governor Company.

**SARNIA**
L. J. Hall, 730 Talfourd St., Sarnia, Ont., Canada. Tel: EDgewater 2258.
Third Monday, 8:00 P.M., Y.M.—Y.W.C.A.

**SAVANNAH RIVER**
F. P. Ledford, Jr., c/o Field Project Manager Ga.,
E. I. du Pont de Nemours and Co., Box 117 Augusta, Ga.

**SOUTH TEXAS**
H. C. Givens, La Gloria Corp., P.O. 637, Falfurrias, Texas. Tel: 122-W
First Wednesday. Meeting at 7:30 P.M.

**SOUTHERN MICHIGAN**
Lyle J. Draper, 2233 Oakland Dr., Kalamazoo, Mich.
Fourth Wednesday, 8:00 P. M., Dinner at 6:30 P. M., Chicken Charlie's, Kalamazoo.

**ST. LOUIS**
W. G. Lee, 4710 Delor St., St. Louis 16, Mo. Tel: FL 8516.
**First Wednesday After First Monday, Meeting at 8:00 P.M., Engineer's Club of St. Louis.**

**TOLEDO**
P. H. Girkins, 418 Waggoner Blvd., Toledo 12, Ohio. Tel: LA 6505
Third Tuesday, Meeting at 8:00 P. M., Service Bldg., Toledo Edison Co.

**TENNESSEE**
James L. Williams, 2237 Bruce St. Kingsport, Tenn. Tel: 2079-L
Fourth Thursday, Civic Auditorium.

**TULSA**
A. J. Sesock, 845 South East Ave., Tulsa, Okla., Tel: 8-1112
University of Tulsa Campus, Petroleum Bldg.
First Monday, Meeting at 7:30 P.M.,

**TWIN CITIES**
John L. Schmidt, 1879 University Ave., St. Paul 4, Minn., Tel: DR 0064
**Fourth Tuesday, Dinner at 6:30 P.M., Meeting 7:30 P.M., Rm. 353, Coffman Memorial Union, U. of Minn.**

**WASHINGTON**
Edward C. Lloyd, 2105 Spencer Road, Silver Spring, Md. Tel: SH. 9340.
Third Monday, Meeting at 8:00 P.M., P. E. P. Co. Auditorium.

**WAYNE COUNTY**
J. R. McCauley, 18073 Archdale, Detroit 19, Mich. Tel: KE 1-5239.
Third Monday, Meeting at 8:00 P.M., Larson's Cafe, Lincoln Park, Mich.

**WILMINGTON**
E. Avery Taylor, Taylor Instrument Co., Industrial Trust Bldg., Rm. 510, Wilmington, Del. Tel: 9814
Third Tuesday, Meeting at 8:00 P.M. Harlan Public School, Wilm.

ISA
EMPLOYMENT SERVICE
*Forward your letter to INSTRUMENT SOCIETY OF AMERICA*
1319 *Allegheny Ave.,*
*Pittsburgh* 33, *Pa.*

**INSTRUMENT ENGINEER. For nationally-known industrial leader. A graduate engineer with 10 years practical and theoretical experience in instrumentation will find this an excellent opportunity with a young and expanding division of a leading company. Should have broad background in electronic controls, design and development of electrical circuits and temperature, pressure, electrical and hydraulic instrumentation. Position is in Cincinnati area, in a modern plant. Advancement opportunities and many benefits. Send complete resume. Box 761.**

**SALES ENGINEER. Graduate in Chemical Engineering, 25 to 30 years of age, for sales position handling chemical and other pumping machinery in Chicago area with well established firm of manufacturers' representatives. Please send resume of experience and salary. Box 762.**

**INSTRUMENT ENGINEER. Electrical Engineer for expansion of meter development laboratory to assist in the development of commercial and military electrical indicating instruments, using various types of movements commonly associated with indicating meters. Must have knowledge of fundamental electrical circuits, and also fundamental mechanical problems associated with instrument design. Previous experience in manufacturing plant preferred but not necessary. Plant located east side in Cleveland, Ohio. Box 708.**

**INDUSTRIAL INSTRUMENTATION SPECIALIST. Successful, progressive chemical company offers challenging opportunities to specialist in the development and application of control instruments for chemical processes. The man we are seeking may be an engineering physicist, a physical chemist, or an electrical engineer. In addition to a B.S. or M.S. and approximately five years of industrial experience, he must have the ability not only to adapt instruments to new uses, but also to develop new instruments for new processes. If you believe you are this man, it will pay you to write at once giving complete details of education and experience. Your reply will be kept confidential. Box 760.**

---

# Operation of a Semi-continuous Process Using the Kinegraphic Control Board

By JOHN E. READ* and JOHN JOHNSTON, JR.**

**ABSTRACT—Diagramatic arrangement of process flow lines, signal lights, valve operators, and miniature instruments in the pattern of the process flow diagram are described as contributing significantly to simplification, ease of interpretation, and safety in the operation of complex chemical manufacturing processes. Automatic sequential control of specially designed piston actuated valves is described.**

CONCEIVABLY, the mechanism of chemical plant operation may some day become so completely and dependably automatic that a minimum of human supervision will be necessary. Toward that end, two general types of instrumentation seem to be coming into general use. In one, all operational responsibility is taken from a human attendant and placed in a hermetically sealed black box. The customer or operator has a single knob with which he adjusts the production rate of his equipment to match the availability of raw materials or the demand of the market. With this arrangement the operator need know absolutely nothing about the internal construction of the black box nor about the chemistry of his process.

The other type exploits automatic operation but keeps a technically qualified human operator in supervisory control. Information is collected and converted to intelligible use in simplified form. Supporting details and factors going into the interpretation are independently recorded for use if needed. This instrumentation displays detailed and accurate information about material and energy consumption plus a measure of the qualities relevant to economic production. The qualified operator then manipulates his controls to match the observed conditions with those calculated to produce efficiently.

In other words, the process can either be so completely automatic that an unskilled attendant is sufficient; or selective information can be supplied by means of instrumentation for use by the technically qualified in the most efficient operation of the process.

The latter approach is exemplified in today's monitoring systems, where a large number of variables are checked periodically at high speed. If one of these points should vary from a prescribed pattern, the entire mechanism

*Senior Instrument Engineer, Engineering Department Design Division E. I. du Pont de Nemours & Co., Inc., Wilmington, Delaware.

**Instrument Consultant Supervisor, Engineering Service Division E. I. du Pont de Nemours and Co., Inc., Wilmington, Delaware.

---

Presented before the Sixth Annual Conference of the Instrument Society of America, at Houston, Texas, Sept. 10-14, 1951.

**Statements and opinions expressed herein are those of the authors, and not necessarily those of the Society.**

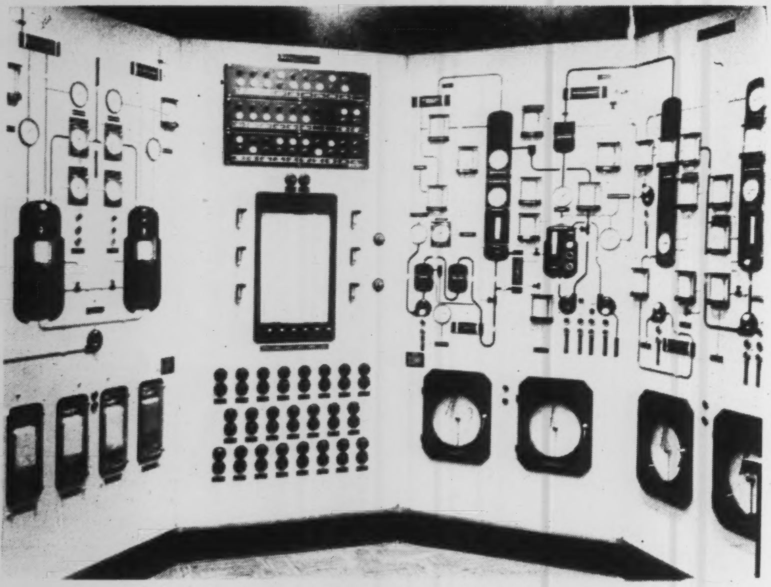


Fig. 1. Standard version of graphic panel for static process.

becomes a recording or computing machine, delivering information for use by the trained analyst in determining the cause of the deviation and in effecting a correction.

### Graphic Panels

A more common example of this trend is the modern control center which combines miniature instruments in a graphic display of process equipment arrangement, with the symbolized route and inter-connection of process piping and the appropriate location of measurement and control devices on a mimic flow diagram. This constitutes what has become known as the graphic control board. By its means, complex operational information is reduced to its simplest terms and presented to the operator in such form that mistakes and mis-interpretations are minimized. As used to date, (Fig. 1), it is considered by many to be ideally suited to simplification of those complex continuous processes whose flow pattern is static.

Ever since the first installation of the graphic panel in its standard form, there have been numerous arguments about its justification. Is it winning acceptance because of lower cost, superior performance, or reduced space requirements? We think not! Eye-appeal and the fascination responsible for the popularity of model railroading exert important influence, but SAFETY and SIMPLIFICATION are the prime attractions.

This is particularly true, for example, in a process using dangerously incompatible fluids which must alternately be passed through the same piece of equipment. Control of such a process may be likened to the operation of a railway system. Here graphic instrumentation is justified on the same basis as is the master control panel in the railroad dispatcher's office. That basis is safety and safety alone; for simplification contributes to safety through accelerated understanding and increased accuracy of operation.

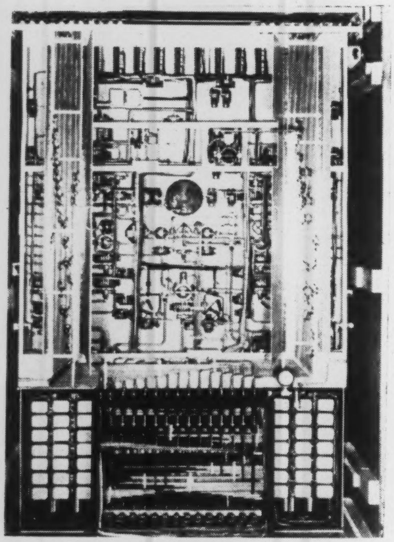


Fig. 2. Rear view of sequence control board.

Although the instrument equipment used to accomplish this may itself seem extremely complex (Fig. 2) it represents a simplification in use and interpretation. This parallels the trend, for example, in today's automobile where operation of the car is the most easily learned qualification for a driver's license. To achieve this simplification, the mechanical design and assembly have become more complex and the talent requirements of the mechanic in repair and trouble shooting are much higher.

This is also true in instrumentation. The interlocked and interconnected instrument system required for fool-proof operation does involve some complication. Although these complications are a source for concern only to the instrument mechanic, the panel should be engineered to enable the mechanic to pin-point quickly any malfunction, thereby doing much to prevent unnecessary difficulty.

### Kinegraphic Panels

This control board (Fig. 3) represents the use of what the author calls "Kinegraphic" instrumentation. For the operator's understanding, there is pictured at any given time (Fig. 4) the exact status of each important valve in the process arrangement, the kind of fluid flowing in each line and the direction of flow. In the example illustrated, a semi-continuous process involves two regenerative converter systems which are alternately on and off stream. Each converter cycle consists of eight operating phases.

During the course of a cycle, 28 process valves must be manipulated in approximately 100 combinations. Nineteen of these valves (Fig. 5) are interlocked so that they can be operated safely only if all process conditions are in a safe configuration; that is, one particular valve can not be opened unless it has been definitely established that certain other valves are closed. Further, it is not sufficient that closure be indicated by stem position, but rather, and more positively, by a measure of the leakage rate of an inert

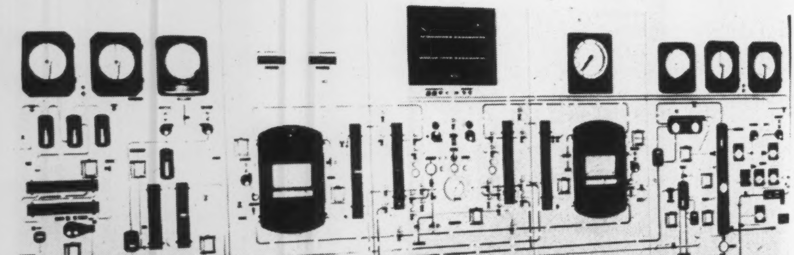


Fig. 3. Kinegraphic control board used where processing streams change in identity and direction.

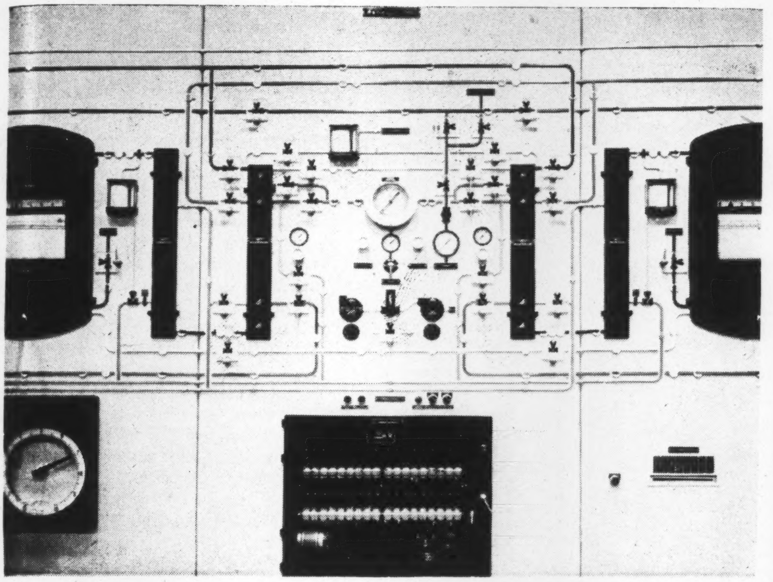


**Fig. 4.** Close-up view of dynamic portion of the board showing colored lines and illuminated symbols.

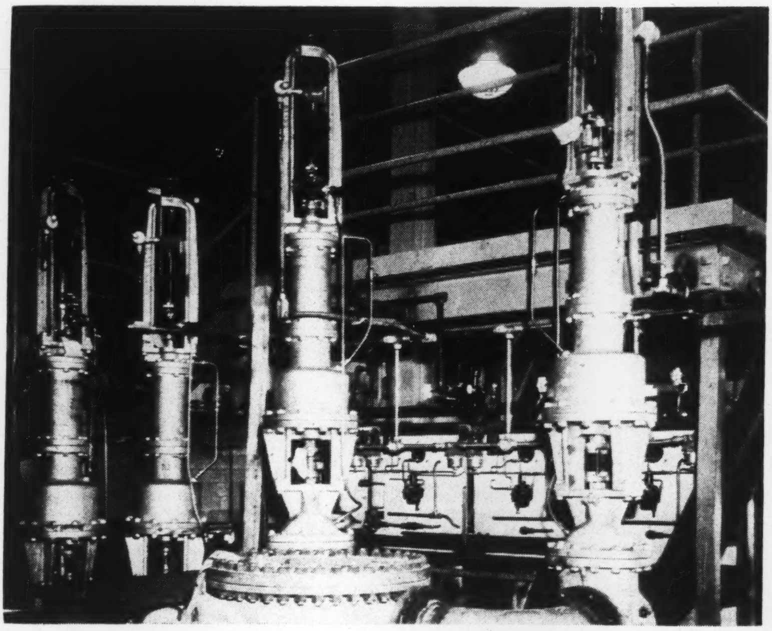


**Fig. 5.** Piston-actuated process valves operated automatically from sequence controller and interlocked to prevent inopportunte operation.

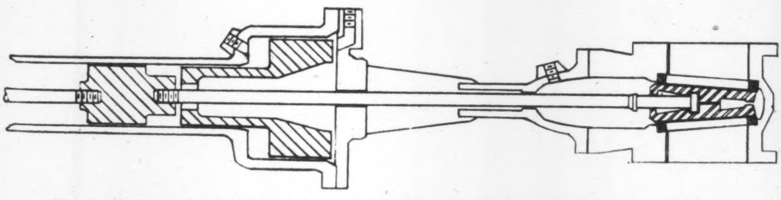


**Fig. 6.** Cross-section of gate valve showing loose piston for delivering hammer blow.

fluid from the bonnet space past the seat rings to the adjoining pipe line. If the leakage be limited to a predetermined minimum, as indicated by a sustained pressure in the valve bonnet, then that valve can be considered closed so far as subsequent safe operation is concerned.

### VALVE DESIGN

In order to present the interlock picture design of the process control valves must be described further. In its early conception, the project called for Hamer line-blind flanges, which were to be removed and replaced at the completion of each phase in the conversion cycle. This design was accepted as a part of the penalty for safe operation of a hazardous process, even though it did not preclude the possibility of operator error. Considerable operating labor and time would have been consumed in closing large valves by hand, removing or inserting blind flanges, then again opening the large valves in order to switch converters. This, coupled with the physical effort and discomfort under existing operating conditions would have contributed a great deal to the cost of operation.

Substitution of the bonnet purged, split-wedge, gate valve (Fig. 6) was suggested as being equally safe. This idea was favorably received. A design was developed using pneumatic piston actuation, with a second piston arranged to deliver a hammer-blow for opening the valve in case of stickiness. The pneumatic cylinder was considered superior to electric-motor or hydraulic actuation in terms of dependability and speed of operation. Trouble-free performance for the past several years has validated this selection.

When the idea of remote operation was received favorably, a fully automatic and completely interlocked sequential operator was developed. This was accepted on the basis of safety and freedom from the possibility of erroneous operation. Automatic control of the cycle is realized through the use of a 36-function sequence controller (Fig. 7). Each of the 100 positions of the sequence controller calls for a distinctively different process circuit.

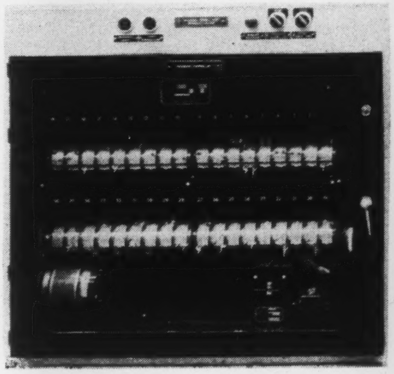


**Fig. 7.** 36-function sequence controller with 100 operational steps.

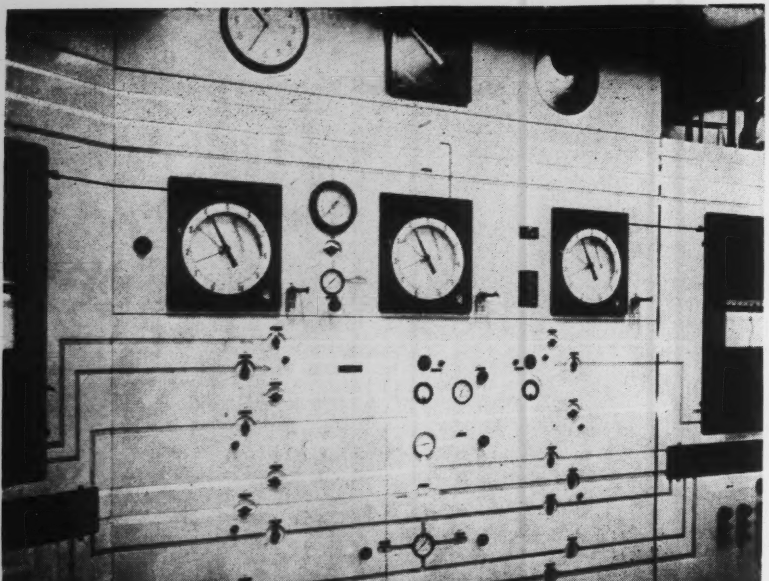


Fig. 8. Control board built in 1947 using electrical actuation and interlock.

The operation follows a pattern prescribed by the sequence controller which establishes step by step each of the different process circuits, in turn. At each step, safety is verified before the sequence controller can advance to its next position. This provides a safe interlock to prevent out-of-phase operation or unsafe continuity of operation.

Each of the 19 process valves is interlocked independently so that it can not be operated in an unsafe arrangement. The completion of each valve operation is signalled to the control board. If, for any reason, the operation is not completed, the sequence controller is prevented from advancing to the next position and a visual and audible alarm occurs. Also, the process valves can be manipulated independently from the control panel by the operator. This remote manual operation is similarly interlocked to prevent the possibility of explosion or fire.

Automatic sequence control insures (1) correct continuity of operational steps, (2) prevention of operator error which may cause process shutdown, and (3) timed purging periods to assure removal of explosive gases or air prior to a change in cycle. For manual operation, this is dependent on the judgement and training of the operator.

### ORIGINAL CONTROL BOARD

A control board (Fig. 8) was built in 1947 to meet these objectives. In this design an arrangement of colored plastic strips was back lighted to symbolize the process streams. Operation was entirely electrical. The sequence controller actuated cam-operated electrical switches to energize or deenergize solenoid operated valves in the air supply to the large piston-operated process valves. Limit switches were attached to each process valve to signal attainment of the full open or tightly closed position.

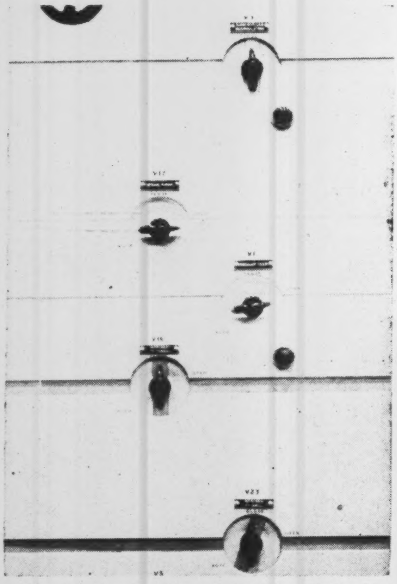


Fig. 9. Close-up view of 1947 board showing valve position indicators and remote manual actuators in back-lighted flow diagrams.

This was manifested in the control room by a specially designed valve position indicator (Fig. 9). The indicator was solenoid operated and assumed a position across the symbolized normal flow whenever the valve was closed. Conversely, when the valve reached the open position, the rotary indicator assumed the appearance of continuity. Simultaneously, the section of line symbolizing flow beyond the valve was illuminated. A number of difficulties were experienced in the operation of the early unit. These were ascribed to the following:

(1) Solenoid valves were found to be not too dependable in continuously energized operation.

(2) Valve position indicators required frequent service.

(3) Valve limit switches had to be rebuilt more ruggedly.

(4) The cam type timer was difficult to adjust due to the large number of steps and the small intervals. Although these shortcomings are being corrected, the second unit had to be designed with these factors in mind.

It was, therefore, decided on the second unit wherein:

(1) Pneumatic pilots and operators were used instead of electrical switches and solenoid valves.

(2) An illuminated symbol with no moving parts was substituted for the valve position indicator.

(3) Rugged pneumatic switches were built very carefully into the valve structure in order to give more reliable indication of valve position.

(4) A sequence controller with snap action and ease of adjustment was used for higher accuracy of setting.

### INTERLOCK

When these changes were incorporated, it became evident that pneumatic pilot pressures could be used as part of the interlock system. Further discussion of the effects of this substitution requires an understanding of the signalling devices mounted at the gate valves and their function in the safety interlock.

Electrical limit switches had been mounted at the ends of stroke of the process valves (Fig. 10). A bonnet-purge valve was mounted at the bottom of stroke. The bonnet-purge steam is admitted when the gate valve is in

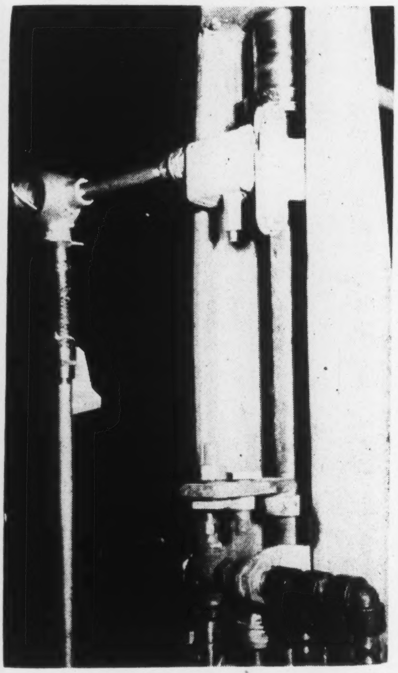


Fig. 10. Close-up view showing stem actuated valve limit switches, interlock valves and bonnet purge valve.

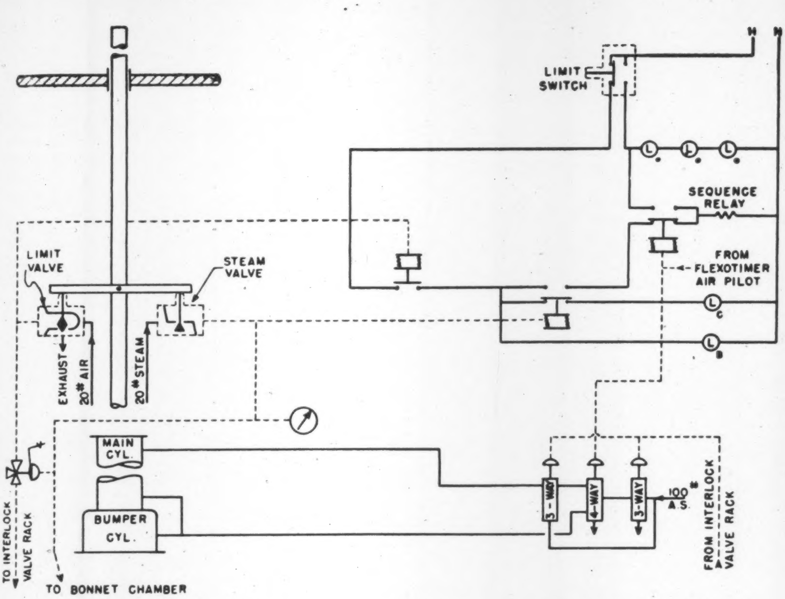


Fig. 11. Interlock diagram for pneumatic interlock of piston actuated valves.

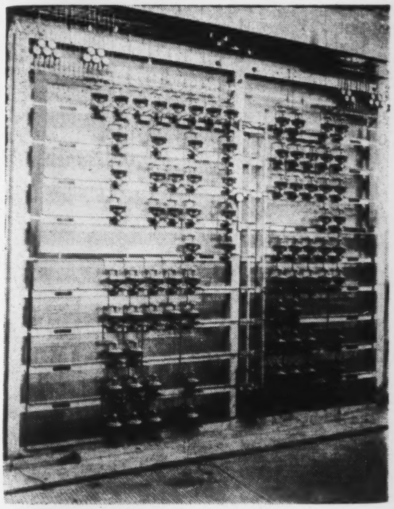


Fig. 12. Interlock valve rack where 80 pilot valves interlock the operation of 19 process valves.

its closed position. If the gate valve fits tightly, there will be no steam leakage and the bonnet-purge pressure is sustained. However, if leakage through the gate should exceed the capacity of the small supply valve, the steam pressure will fall below a prescribed value; the pressure switch will sound an alarm to signal this unsafe condition and cause the cycle to stop until the operator takes corrective steps. The substitution of a pneumatic for an electrical interlock system necessitated considerable change in the arrangement of the valves. A small pneumatic pilot valve was substituted for the lower limit switch. This is actuated at the closed position of the gate valve. The gate valve must be in the closed position and the steam pressure above the safe value before the sequence controller can advance or before companion interlock valves can be opened.

How this is accomplished can best be understood by reference to the typical interlock diagram (Fig. 11). Here it is seen that the 80 psi air supply to actuate the large piston valves can only reach its destination if called for either by the sequence controller or by the manual operator and provided the interlock actuated three-way valves are in the proper positions.

The interlock relationship is illustrated on the interlock table (Table I) which shows, for example, that valve 52 cannot be opened unless valves 56, 58, 72, 74, and 68 are all closed. To satisfy this requirement, the wiring and piping must be duplicated 19 times and an array of 80 valves incorporated (Fig. 12). Electrical impulses are used only to illuminate signal lights or to operate the sequence controller. There are no solenoid operated valves in this arrangement and the only solenoid actuator in the entire system is the one in the sequence controller, a Taylor Flex-O-Timer. Where electrical impulses are needed they are supplied by pressure switches.

### Flow Lines and Symbols

In the new control board the interconnecting piping is symbolized by colored aluminum strips. The color chosen corresponds to a piping code for major processed materials. The existence and direction of flow are indicated by illumination of translucent plastic arrows inserted in the line (Fig. 13). Where more than one stream can flow through the same section of pipe, a second arrow is evident having a different color and in some cases a reversed direction.

The valve symbol is fitted with a manual selector by means of which the pneumatic impulse to actuate the process valve can be applied at the discretion of the operator instead of by the automatic sequence controller. Even when the valve is manually actuated, however, the operation is fully protected against explosion or fire. In either case the completion of each valve operation is signalled to the control board.

When a valve reaches its full open condition, the "shut" pilot light goes out and an "open" pilot light comes on. Also, the colored representation of that particular line beyond the valve is illuminated by the pilot-lighted arrows showing the direction of flow and color-coded material. Illumination of the mimic piping by means of colored, directional, pilot lights assures absolute certainty about process flows. The lighted, bar-shaped signal or the lighted arrow at the valve symbol can not be misunderstood even by the color-blind.

### Diagnosis of Abnormality

On automatic control the sequence operator "masterminds" the transfer from one conversion phase to another. A pneumatic function calls for process valve actuation; the valve is actuated, provided the interlock has been satisfied; the sequence controller is stopped until the proper response has been

TABLE I—Process valve interlock table. Numbers correspond to previous valves.

VALVE INTERLOCK

| | CODE | 52 | 54 | 56 | 58 | 76 | 72 | 74 | 68 | 66 | 70A | 51 | 53 | 55 | 57 | 75 | 71 | 73 | 67 | 65 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NO. 4 CONVERTER | 52 | | | C | C | | C | C | C | | | | | | | | | | | |
| | 54 | | | C | C | | C | C | C | | | | | | | | | | | |
| | 56 | C | C | | | | | | | C | C | | | | | | | | | |
| | 58 | C | C | | | | | | | C | C | | | | | | | | | |
| | 76 | | | | | | C | C | | | | | | | | | | | | |
| | 72 | C | C | | | C | | | | C | C | | | | | | | | | |
| | 74 | C | C | | | C | | | | C | C | | | | | | | | | |
| | 68 | C | C | | | | | | | | | | | | | | | | | |
| | 66 | | | C | C | | C | C | | | | | | | | | | | | |
| | 70A | | | C | C | | C | C | | | | | | C | C | | C | C | | |
| NO. 3 CONVERTER | 51 | | | | | | | | | | | | | C | C | | C | C | C | |
| | 53 | | | | | | | | | | | | | C | C | | C | C | C | |
| | 55 | | | | | | | | | | C | C | C | | | | | | | C |
| | 57 | | | | | | | | | | C | C | C | | | | | | | C |
| | 75 | | | | | | | | | | | | | | | | C | C | | |
| | 71 | | | | | | | | | | C | C | C | | | C | | | | C |
| | 73 | | | | | | | | | | C | C | C | | | C | | | | C |
| | 67 | | | | | | | | | | | C | C | | | | | | | |
| | 65 | | | | | | | | | | | | | C | C | | C | C | | |

C—Closed

Valves in left-hand column can be opened only when cross-referenced valves are closed as indicated.

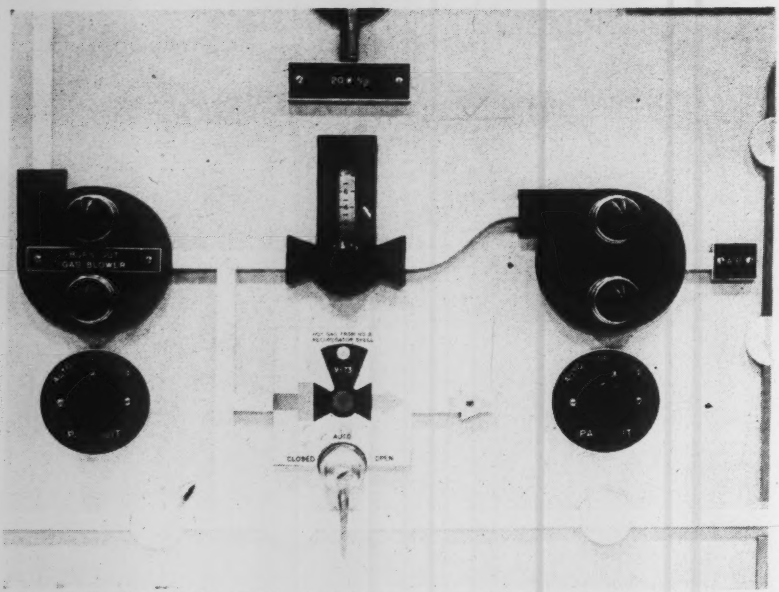


**Fig. 13. Illuminated valve symbol and plastic arrows are used to indicate direction and identity of flowing streams.**

obtained; the sequence operator starts when everything is clear; the next function is then called for, and so on. Each step is dynamically apparent on the illuminated pattern.

If some abnormal condition should occur during automatic operation, the normal interlock response is lacking for the Flex-O-Timer to continue its sequencing and this absence of a response within a preset time period sounds an alarm. At this point the control room operator need refer only to a sequence position indicator (Fig. 14) to detect quickly the offending function. This indicator is presented as an example of a trouble-shooting device which is a "must" in the design. In operation, the large, back-lighted disc rotates in register with the sequence controller drum. At any given time, an illuminated number indicates at a glance which valve is being actuated, what phase is in progress, and whether the valve is opening or closing.

With reference to an earlier mention of the panel designer's responsibility toward the instrument mechanic, considerable effort was expended both on the sequence indicator and on the pneumatic interlock system to simplify trouble-shooting in the plant. Provision was made so that the control room operator himself could do a substantial amount of checking by referring to the sequence indicator, the interlock pressure gauge, the purge steam pressure gauge and to the positions of interlock valve. These provisions were believed justified on the basis that if trouble-shooting were too involved, the operator might well develop the attitude that automatic sequence control was not to be counted on, and he would simply operate the process manually. For this reason, the major interlock components were literally brought out into the open. At the easily accessible rack and valve panel, operators and mechanics alike can actually watch interlocks taking place. Through association and understanding there develops in the operator that same confidence in operation he holds for other items of process equipment.

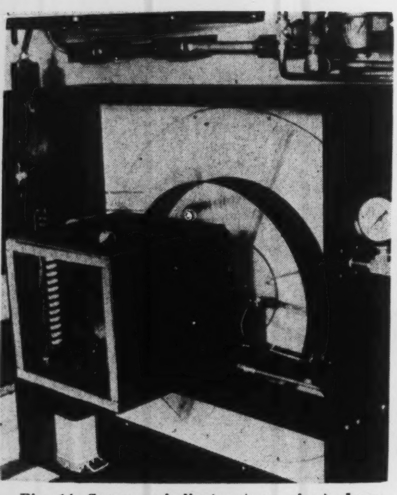


**Fig. 14. Sequence indicator (rear view) shows status of operation. Process steps and valve operation are indicated on illuminated strip seen from front of panel.**

### OPERATOR RESPONSIBILITY

There are some aspects of the operation which are not readily susceptible to automatic control. This is because of the necessity for judicious manipulation of process variables to suit a variety of conditions. At such points, the sequencer stops and an alarm sounds, to transfer responsibility to the human operator. He observes trend and pattern and adjusts controller settings and the like to suit operational requirements.

One of these patterns is that of temperature within the converter. Each converter is fitted with 25 points of temperature measurement, only 12 of which are recorded at one time. It is desired to observe the temperature gradient of various levels throughout the progress of this period. A compound multi-point selector switch has been obtained and wired in such a way that for each of its 7 positions, 12 of the 25 thermocouples are recorded. The 12 chosen produce a pattern which is related to the progress of the cycle.

The operator must observe this pattern and adjust the distribution of energy sources accordingly. The provision of the pattern switch has greatly simplified the interpretation of this as a process variable.

### CONCLUSION

It is felt that the use of a pneumatic interlock system to the extent outlined is an advance over previous systems and that it offers many advantages. The authors believe that the need for major repair to an electrical equivalent will be evident. All of the components of the system are simple mechanical devices. Their operation or misoperation is easily detected. Any possible need for major repair seems extremely remote.

With pneumatic energy supplied to those elements requiring power for dependable operation and electricity to those where signaling is desired, the best attribute of each of these energies has been used. This, combined with intelligent operation, utilizing the kinegraphic control board, seems to provide the most usable form of today's instrumentation for a semi-continuous process. The ideas have been accepted enthusiastically by operating people in the authors' company. This experience indicates that the kinegraphic control board offers a new approach to operational simplicity and safety of the ever more hazardous and complicated chemical process.

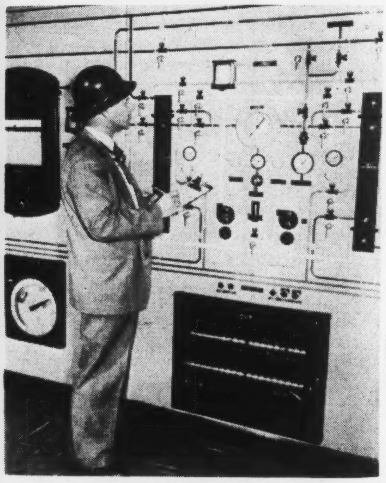


**Fig. 15. Instrument engineer checking operation of panel prior to start-up.**

# Improved Flow Control With Long Lines

By W. E. VANNAH* and A. R. CATHERON*

THIS paper is one of a series of papers reporting on the progress of a project conducted for the study and improvement of flow control systems. Our criterion of improvement is based upon reduction of the magnitude and duration of deviation from a control point in the presence of load disturbances. Earlier papers have been presented by Messrs. Bradner and Catheron. Bradner[1] reported on the dynamic characteristics of pneumatic transmission lines in considerable detail.

Catheron[2] presented the results of a thorough investigation of the effects of flow meter, transmission line, and valve motor dynamics on flow control. He demonstrated improvement in flow control by improving the dynamics of the valve motor. Substantial reduction in over-all time constants of the control system and consequent reduction in reset time produced a decrease in recovery time.

Flow meter dynamics had been improved by the substitution of a high-speed force-balance pneumatic differential pressure transmitter for the more generally used mercury flow meter. Valve motor dynamics and transmission line termination characteristics were improved by driving the valve motor with a volume booster. Experimental results clearly showed that it was the large volume of the valve motor at the end of the ¼-inch tube transmission line and not the transmission line itself which had made the major contribution to the long recovery time following a load disturbance.

Once the characteristic times of the flow meter transmitter and valve motor were minimized, we were led to the desirability of improving the transient characteristics of the transmission lines in those installations wherein long transmission lines were used.

### DEVELOPMENT OF LINE COMPENSATOR

The problem was treated as the development of a device which would provide an optimum compensation for the dynamic characteristics of a transmission line. For this purpose, the transmission line was considered as a process to be controlled. That is, with a pressure applied to the device, we wished to devise a control system which would cause the pressure at the far end of the transmission line to reach the level of the applied pressure as quickly as possible.

This can be done if the applied pressure and the pressure at the far end of the line are compared and their difference amplified by a high gain pressure amplifier which feeds the transmission line. This is similiar to the procedure which is followed when a proportional controller is applied to any process.

Fig. 1 is a block diagram of the system just described. Let us assume for the moment that there is no delay in the relay of information from the output of the transmission line to the difference detector. Should the difference detector and pressure amplifier not be used, a sudden change in the applied pressure, $P_a$, will result in the response at the far end of the line shown by Curve 1, Fig. 2.

When the difference detector and pressure amplifier are added, and the same change in pressure $P_a$ is repeated, the difference between transmission line output pressure, $P_o$, and pressure $P_a$ is initially amplified to the peak shown by Curve 2, Fig. 2. Thus the line is driven by a much larger pressure upset than that called for by $P_a$, and $P_o$ changes much more rapidly than when the difference detector and pressure amplifier are not used.

As the pressure difference decreases, the transmission line input pressure, $P_1$, decreases, subsequently going below the level of $P_a$ because $P_o$ momentarily exceeds $P_a$. The undershoot of $P_1$ rapidly reduces the overshoot of $P_o$. As a result, $P_o$ quickly settles to the level of $P_a$. The behavior of $P_o$ during this sequence of events is shown by Curves 3, Fig. 2.

### USE OF SECOND TRANSMISSION LINE

Since the output of an identical transmission line connected to the pressure amplifier is the same as the output of the first transmission line, we may constantly have a measure of transmission line output. The arrangement is shown in Fig. 3. Fig. 3 also shows that a line compensator can be made by inserting a transmission line, identical to the transmission line we wish to compensate, in the feedback of a narrow band proportional controller. In Figs. 3 and 8, the important components of the line compensator are shown as separated from each other for ease in studying the effects of each component. Subsequently, it will be demonstrated that the line compensator is a simple integrated unit assembly.

The undesirability of using two transmission lines to do the job of one is quite apparent. Hence the next step is to devise a "dummy" line. In early stages of this development, it was believed that the dummy line should have characteristics as nearly like the characteristics of the line to be compensated as possible. To evaluate this hypothesis, considerable effort was devoted to the perfection of a reasonably accurate dummy line.

It is apparent from Iberall[5] that the pneumatic transmission line is a distributed system, indicating that its performance cannot be correctly expressed by lumping its parameters. However, quantitative data from the appendix of Bradner's paper shows that a transmission line can be represented in a practical way by a chain of three pneumatic delay circuits in series. This, of course, is not theoretically correct.

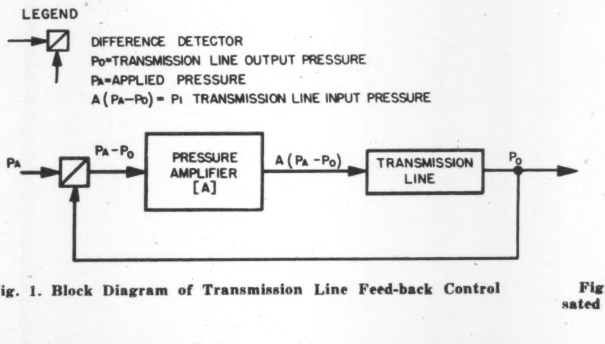


Fig. 1. Block Diagram of Transmission Line Feed-back Control

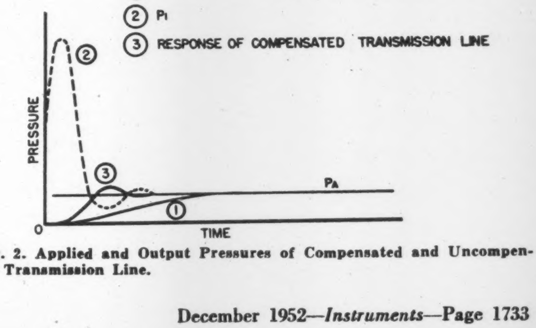


Fig. 2. Applied and Output Pressures of Compensated and Uncompensated Transmission Line.

---

*Research Engineers, The Foxboro Company, Foxboro, Mass.

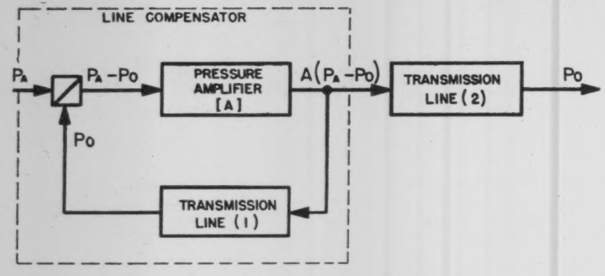
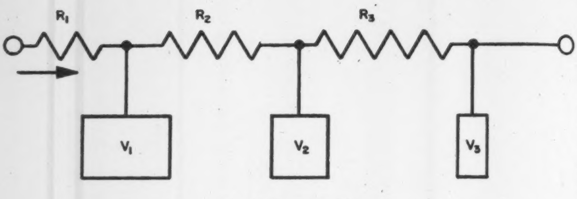


Fig. 3. Block Diagram of a Line Compensator.



$R_1 V_1 = R_2 V_2 = R_3 V_3$
$R_3 = KR_2 = K^2 R_1$
$V_1 = KV_2 = K^2 V_3$

Fig. 4. Circuit Diagram of Triple Capacity Pneumatic Dummy Line.

The difficulty in building an analog, or a dummy, of a pneumatic transmission line lies in the reproduction of transmission line dead-time* due to the velocity of sound in the medium. Electrically, this may be closely approached by the use of R-C** delay circuits isolated by cathode- followers. An analogous pneumatic circuit would be complex and unnecessarily cumbersome.

## Design of Suitable "Dummy" Line

A mathematical analysis of pneumatic R-C circuits indicated that a satisfactory dummy line could be made by connecting a number of pneumatic R-C delay circuits in series, all with equal time constants, but with the resistances arranged to increase in even multiples from input to output and the capacities to decrease in the same order. The circuit diagram is given in Fig. 4. A confirming check of the analysis was obtained with an analogous electrical circuit shown in Fig. 5.

Work with electrical analog circuits indicated that a properly designed double R-C circuit would provide nearly as good a dummy line as the triple R-C circuit. Consequently, the pneumatic circuit shown schematically in Fig. 6 was constructed. Its response to a change in applied pressure is compared with that of the transmission line in Fig. 7. The response of a single R-C dummy line is also shown.

The circuit shown in Fig. 6 does not produce a true dead-time, but it does produce an equivalent dead-time. The single R-C produces no equivalent dead-time and hence is not an authentic dummy line. Fig. 8 shows a transmission line driven by a line compensator without feedback and with three types of dummy line in the feedback.

The comparative performance of the same line driven by the compensator with each of the three types of dummy line in its feedback loop is shown in Fig. 9. Curve 1 shows the result of no feedback and no pressure amplifier; while Curves 2, 3, and 4 represent the performance obtained with dummy lines made of an identical line, a single R-C circuit, and a double R-C circuit, respectively. A 20 per cent overshoot was allowed in order that the transmission line output pressure assume the level of a new applied pressure in a stable manner as rapidly as possible.

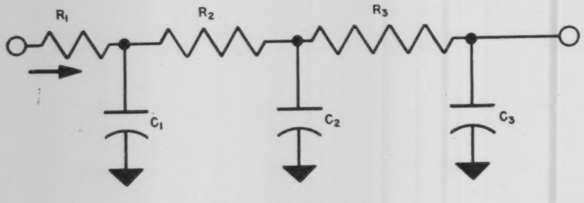
Curves 3 and 4 have approximately equal merit. Consequently, we find it difficult, from a performance viewpoint, to choose between a line compensator with double R-C feedback and a line compensator with single R-C feedback. Even though the single R-C is not nearly as accurate a dummy line as the double R-C, the performance obtained when it is placed in the feedback of a line compensator is satisfactory.

## Configuration of Line Compensator

Fig. 10 is a schematic diagram of a line compensator. Bellows *A* receives the applied pressure. The sum of the moment-area products of bellows *B* and *C* is equal to the moment-area product of bellow *A*; hence the output pressure is equal to the demand pressure in the steady state.

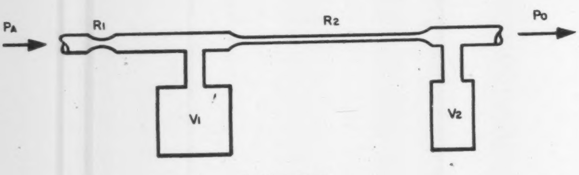
---

*Also known as "transportation lag."
**resistance-capacity.



$R_1 C_1 = R_2 C_2 = R_3 C_3$
$R_3 = KR_2 = K^2 R_1$
$C_1 = KC_2 = K^2 C_3$

Fig. 5. Diagram of Analogous Electric Circuit



$R_1 V_1 = R_2 V_2$
$R_2 = 6R_1$
$V_1 = 6V_2$

Fig. 6. Schematic Diagram of Double R-C Pneumatic Dummy Line.

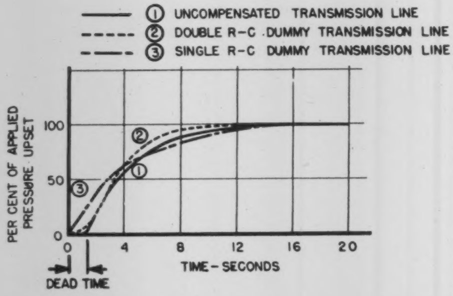


Fig. 7. Responses of 500 ft. of Uncompensated ¼-inch Transmission Line and Two Dummy Transmission Lines.

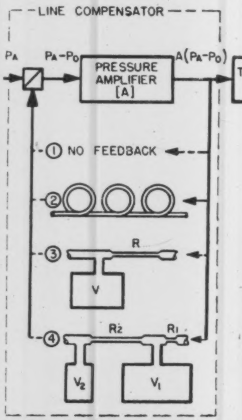


Fig. 8. Methods of Driving A Transmission Line.

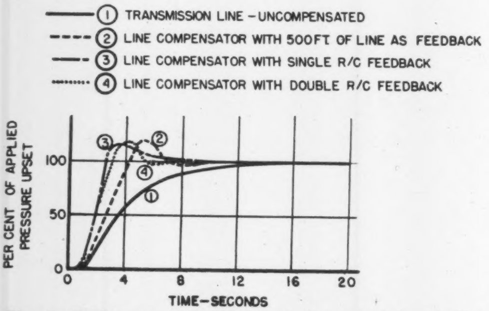


Fig. 9. Performance of 500 ft. of Compensated and Uncompensated Line.

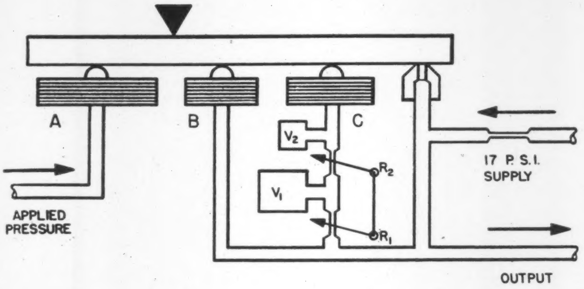

A
B
C
$V_2$
$V_1$
$R_2$
$R_1$
APPLIED PRESSURE
17 P.S.I. SUPPLY
OUTPUT

Fig. 10. Schematic of Receiver Type Line Compensator.

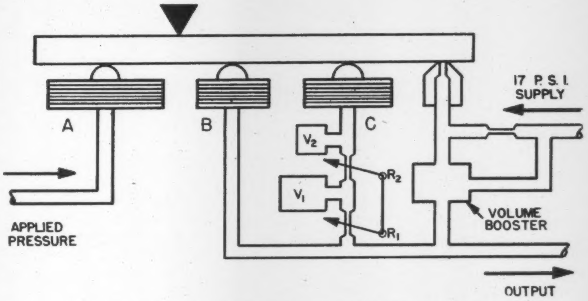

A
B
C
$V_2$
$V_1$
$R_2$
$R_1$
17 P.S.I. SUPPLY
APPLIED PRESSURE
VOLUME BOOSTER
OUTPUT

Fig. 11. Schematic of Transmitter Type Line Compensator

Bellows *B* has an area considerably smaller than that of bellows *C* and is located closer to the pivot. Thus, when the pressure in bellows *A* is larger that that in bellows *C*, a large pressure is developed in bellows *B* to maintain torque balance. When this condition exists, the output pressure is large, since bellows *B* is connected directly to the nozzle and the output. Consequently, the output pressure follows Curve 2 of Fig. 2 when a change is made in applied pressure.

$R_1$ and $R_2$ are variable and can be linked together for double R-C feedback, since the compensator is designed to have one adjustment for the length of line to be compensated. To obtain single R-C feedback, $R_2$ is set to zero, and there is one adjustment of $R_1$ for length of line.

Two types of line compensators were built for experimental use. One was a transmitter type line compensator, illustrated in Fig. 11. The other was a receiver type shown in Fig. 10 (note the lack of a volume booster). The two types were built because we wished to study the relative merit of locating a line compensator in various parts of a flow control loop.

Fig. 12 shows four locations which were considered for line compensators. Those used in Locations 1 and 3 would be transmitter types, and those used in Locations 2 and 4 would be receiver types, requiring no volume boosters. Our tests to determine preferred location led to the conclusion that the line compensator may be used at any point in the circuit as far as general performance is concerned.

Simplicity of construction indicates it should be located ahead of the controller. However, there is no reason at present why the function and principles of the line compensator cannot be included in some other element of the control system.

For instance, it might be desirable to build the device into a proportional plus reset controller, or into the differential pressure transmitter, be it the high-speed type or the mercury meter type. As a matter of record, an early experimental model of the line compensator consisted of a high-speed pneumatic differential pressure transmitter with its feedback system replaced by the system shown to the right of the pivot in Fig. 11.

## PERFORMANCE TESTS OF LINE COMPENSATOR APPLIED TO FLOW CONTROL

The test apparatus and flow control system are the same as that described in Catheron's recent paper[2]. Fig. 13 is a circuit diagram of the flow control system. In the course of performance tests of the line compensator, 10 per cent load disturbances were made, and the resulting recovery to control point was observed.

There is an infinite number of criteria by which to judge performance. We are not biased in favor of any of them but have selected one and adhered to it throughout the flow control test program. We chose an aperiodic response (i.e., the response of a given system must approach the control point as rapidly as possible, with no overshoot) as our standard and judged performance by measuring the time required to return to within 99 per cent of the control point after a 10 per cent load disturbance. For instance, all of the response curves in Fig. 14 are aperiodic, but only one of them (Number 4) could be considered, by our criterion, to represent the best performance.

Curve 1 (Fig. 14) shows the performance obtained with a flow control system consisting of a mercury meter transmitter, an uncompensated transmission line, a standard proportional plus reset controller, and a line terminating in a valve motor. Curve 2 shows a marked improvement in performance. It was obtained with a system similar to System No. 1 except that the mercury meter transmitter had been replaced by a high-speed differential pressure transmitter.

Connection of a volume booster to the valve motor and reduction of controller reset times to the values indicated in Catheron's paper produced the performance shown by Curve 3. Introduction of a line compensator correctly adjusted for the lengths of line produced Curve 4. The recovery time was thus reduced to approximately 60 per cent of that of System No. 3. The transmission lines employed for this group of tests consisted of 500 feet of ¼-inch line from the differential pressure transmitter and 500 feet of ¼-inch line to the valve.

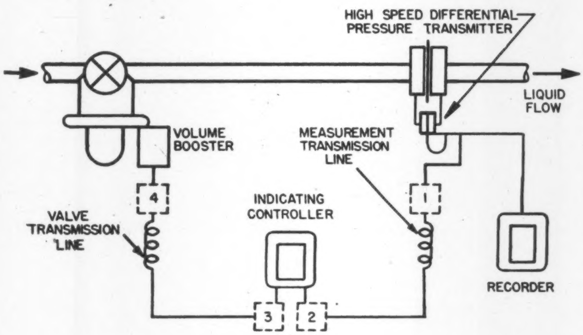

HIGH SPEED DIFFERENTIAL PRESSURE TRANSMITTER
LIQUID FLOW
VOLUME BOOSTER
MEASUREMENT TRANSMISSION LINE
4
1
VALVE TRANSMISSION LINE
INDICATING CONTROLLER
RECORDER
3
2

Fig. 12. Possible Locations for Line Compensators.

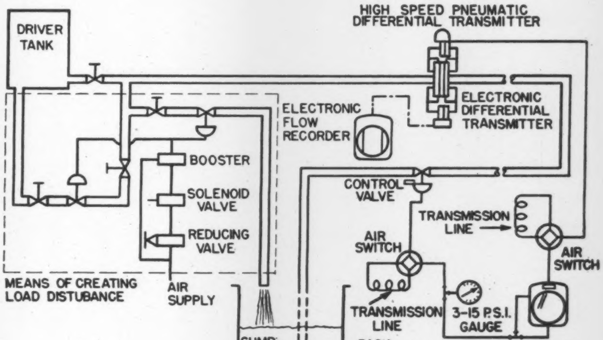

DRIVER TANK
HIGH SPEED PNEUMATIC DIFFERENTIAL TRANSMITTER
ELECTRONIC FLOW RECORDER
ELECTRONIC DIFFERENTIAL TRANSMITTER
BOOSTER
SOLENOID VALVE
REDUCING VALVE
CONTROL VALVE
TRANSMISSION LINE
AIR SWITCH
AIR SWITCH
MEANS OF CREATING LOAD DISTUBANCE
AIR SUPPLY
SUMP TANK
BACK PRESSURE NOZZLE
TRANSMISSION LINE
3-15 P.S.I. GAUGE
FLOW CONTROLLER WITH VALVE MOTOR PRESSURE RECORDER

Fig. 13. Circuit Diagram of the Flow Control System.

| SYSTEM NO | CONTROL SYSTEM | RECOVERY TIME |
|---|---|---|
| 1 | MERCURY FLOW TRANSMITTER | 80 SEC. |
| 2 | HIGH SPEED DIFFERENTIAL PRESSURE TRANSMITTER | 30 |
| 3 | HIGH SPEED DIFFERENTIAL PRESSURE TRANSMITTER, BOOSTER ON VALVE | 12.5 |
| 4 | HIGH SPEED DIFFERENTIAL PRESSURE TRANSMITTER, LINE COMPENSATOR, BOOSTER ON VALVE | 8 |

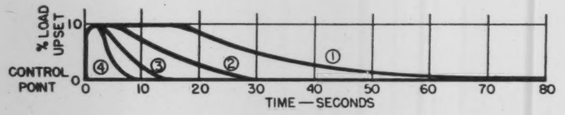


**Fig. 14. Performance of Four Flow Control Systems With 500 ft. of ¼-inch Measurement Line and 500 ft. of ¼-inch Valve Line.**

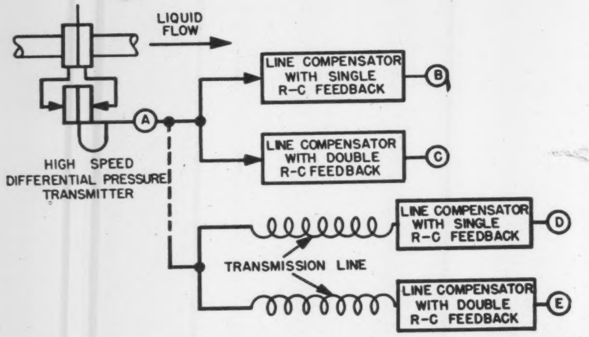

LIQUID FLOW
A
HIGH SPEED DIFFERENTIAL PRESSURE TRANSMITTER
LINE COMPENSATOR WITH SINGLE R-C FEEDBACK
B
LINE COMPENSATOR WITH DOUBLE R-C FEEDBACK
C
LINE COMPENSATOR WITH SINGLE R-C FEEDBACK
D
TRANSMISSION LINE
LINE COMPENSATOR WITH DOUBLE R-C FEEDBACK
E

**Fig. 15. Means of Checking Sensitivity of Line Compensator to High Frequency Variations.**

### OPERATION OF LINE COMPENSATOR WITH HIGH-FREQUENCY VARIATIONS

We are familiar with the high-frequency variations of the signal from a high-speed pneumatic differential pressure transmitter connected across an orifice. A question has been raised as to whether the line compensator described in this paper amplifies the high frequency variations to the extent that maintenance of control point is impaired. The systems shown schematically in Fig. 15 were set up to answer this question. Pressure records taken at points A, B, C, D, and E are reproduced in Fig. 16.

Curve A, (Fig. 16) is a recording of a high-speed differential pressure transmitter after a load upset with no automatic control. Curves B and C are recordings of the outputs of line compensators with single and double R-C feedbacks, respectively, close-coupled to the output of the transmitter. Note the expected peaking due to the delayed feedbacks in response to a step-load disturbance. Note also that the line compensator with double R-C feedback does not pass the higher frequency variations which the line compensator with single R-C feedback does.

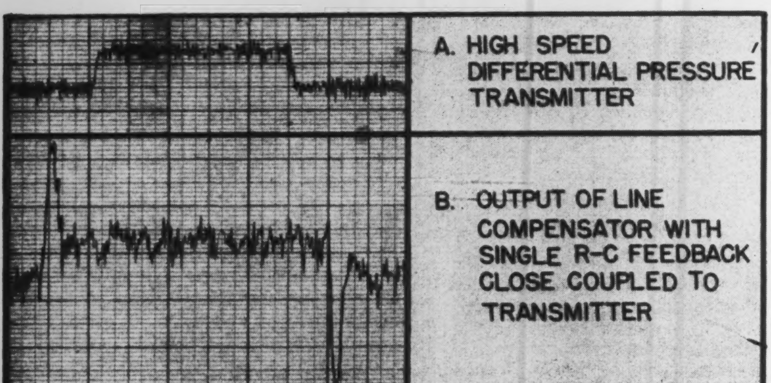


**Fig. 16. Output Recordings of Elements in Flow Control Systems.**

Curves D and E are the recorded outputs of line compensators with single and double R-C feedbacks, respectively, at the end of 500 feet of ¼-inch tubing fed by the differential pressure transmitter output shown in Curve A. There is little to choose between the performances of the two line compensators, although the system record of Curve E indicates a slightly more rapid attainment of the final value than the system record of Curve D.

Next the flow control loop was closed and the curves shown in Fig. 17 were produced by Systems 4 and 3 of Fig. 14, i.e., with and without line compensator. Since all four curves of Fig. 17 are alike, it is evident that a line compensator, correctly adjusted for compensation of a length of transmission line, does not impair the maintenance of control point. The point is established that the relative sensitivity of the line compensator to high-frequency variations does not seem to produce harmful disturbances.

### OVER-ALL EFFECTS OF LINE COMPENSATOR

We have shown that the line compensator reduces the time required for the output of a transmission line to reach and maintain a demand pressure. When the line compensator is introduced into a given control system, recovery time is reduced. Finally, if we assume a maximum allowable recovery time, the transmission line length may be extended by the introduction of a line compensator. This point is illuminated by a broken line drawn on Fig. 18 to represent an allowable recovery time of eleven seconds.

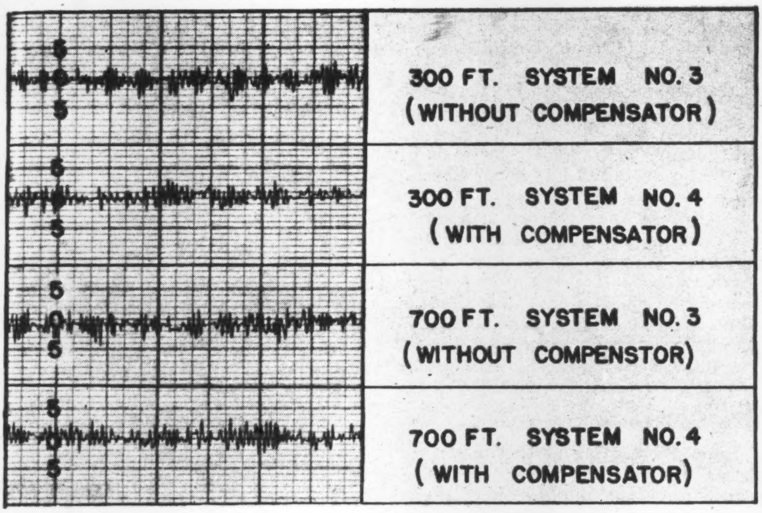


**Fig. 17. Noise Uniformity for Flow Control Systems With and Without Line Compensator.**

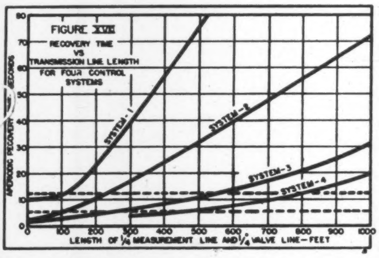


**Fig. 18. Recovery Time vs Transmission Line Length for Four Control Systems**

It is now apparent that the transmission line lengths of the four control systems must be equal to or less than the following to obtain this allowable recovery time:

| *System Number* | *Line Length, Each Way* |
|---|---|
| 1 | 90 feet |
| 2 | 210 feet |
| 3 | 500 feet |
| 4 | 750 feet |

An allowable recovery time of five seconds is represented by a second broken line. The following transmission line lengths are now permissible:

| *System Number* | *Line Length, Each Way* |
|---|---|
| 1 | This system may not be used |
| 2 | 100 feet |
| 3 | 225 feet |
| 4 | 430 feet |

### CONCLUSIONS

We have demonstrated that a pneumatic device, termed a line compensator, with either a single or double R-C delay circuit in its feedback, can reduce the effect of transmission line length. Due to the delayed feedback, the device is, as expected, sensitive to high-frequency disturbances. However, when it is coupled fore or aft of a transmission line and set to match that length of line, the high-frequency disturbances are almost completely attenuated. The useful signals are apparently passed.

Experiment has shown that line compensators with single and double R-C feedback delay circuits have essentially the same performance. It should be noted, however, that the latter does not pass variations of as high a frequency.

Application of line compensators to flow control systems of the present-day type is limited to those which include, for any reason, long transmission lines. With a flow control system arranged as recommended by Catheron, there is a 40 per cent reduction in recovery time when a line compensator is used on lines greater than 200 to 250 feet in length. Given an allowable maximum recovery time, introduction of a line compensator permits transmission line lengths to be extended by 1½ to 2 times.

### ACKNOWLEDGMENT

The authors express particular appreciation for the efforts of Messrs. S. H. Goodhue and S. W. Sweet of The Foxboro Company research staff in conducting the experimental work upon which our conclusions are based.

### REFERENCES

(1) Bradner, Mead, "Pneumatic Transmission Lag," Paper No. 48-4-2, Instrument Society of America.

(2) Catheron, A. R., "Factors in Precise Control of Liquid Flow," Paper No. 50-8-2, Instrument Society of America.

(3) Howe, W. H., "A Consideration of Process Control Servomechanisms," presented on July 25, 1951, at a Servomechanism Conference sponsored by the Department of Scientific and Industrial Research of the British Ministry of Supply.

(4) U. S. Patent No. 2,445,335 to Philbrick, G. A., and Catheron, A. R., assigned to The Foxboro Company, July 20, 1948.

(5) Iberall, Arthur L., "Attenuation of Oscillatory Pressures in Instrument Lines," JOURNAL OF RESEARCH, Volume 45, Number 1, July, 1950.

(6) McDonald, Donald, "Stabilizing Servomechanisms," ELECTRONICS, November, 1948.

(7) Oldenbourg, R. C. and Sartorius, H., THE DYNAMICS OF AUTOMATIC CONTROLS, translated and edited by H. L. Mason, A.S. M.E., 1948.

---

# Putting The Instrument To Work

By H. A. HULSBERG*

BETWEEN engineering and maintenance of plant instruments is the installation or construction period, in which we find the character shown in Fig. 1, whom we will designate as The Ideal Installation Instrument Engineer. You will observe that he has five hands to get things done in the time between receiving the instruments and starting the plant.

### RECEIVING-ROOM STAGE

Hand Number One is specially adapted for what we will call the receiving room installation. One finger through a period of evolution has grown a pen to check invoices against purchase orders, and to wire the home office or

---

*Universal Oil Products Co., Chicago, Ill.
Presented at the Sixth Annual Conference of the Instrument Society of America, at Houston, Texas, Sept. 10-14, 1951.

the supplier for missing items. The thumb is specially flattened to thumb through mountains of papers. We will return to our engineer later to discuss some of his other hands.

### OPENING PACKAGES

During the receiving room stage of installation, the installation man spends his time chiefly with the receiving or storehouse clerk. Upon opening of packages or crates, each shipment is properly identified, checked against the order, any missing items are noted for early expediting. All separate parts are tagged and correctly labelled as to service.

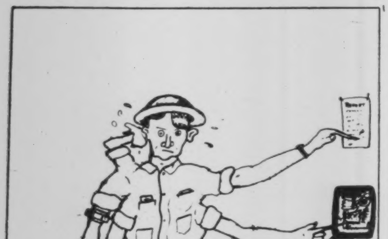


Fig. 1.

Instruction books are properly identified with the service and serial number of the instrument, properly filed, and checked out to construction men when needed. These instructions are later turned over to the plant instrument department, to avoid the annoyance of having instructions appropriated by people who will not later have responsibility for maintenance of the equipment.

Proper storage of instruments frequently is given little consideration. Electrical and other instruments which may be damaged by moisture should be protected by proper housing. A heated room is required when low temperatures may cause condensation with consequent rusting and insulation damage, or may cause freezing of standard cells, ink, or liquid chemicals. After opening and identification, items should be re-boxed wherever possible to protect against petty theft, loss due to confusion, or damage due to rodents (human or other).

### CARE OF ACCESSORIES

Upon installation of the major part of an instrument, any accessories which are not immediately needed should be boxed, labelled, and eventually turned over to the plant instrument man, or whoever is responsible for storage of such items. This includes charts, ink, chemicals, spare parts, special tools, valve lubricant, and the like.

If dry cells included with electrical instruments are not to be used for some time, they may be turned over to plant stock, to be replaced by fresh ones later. As items leave the storehouse for installation, a notation on the invoice or order may be made to avoid misplacement and confusion.

Obviously, since not all instruments arrive at once (some of them never get there these days), the receiving room stage of installation will overlap the stages to follow.

### ROUGHING-IN STAGE

Let's look at Hand Number Two of our Installation Man (Fig. 1). This hand is considerably stronger than the others, since it is specially adapted for the *roughing-in stage* of instrument installation. In it is a hammer to use on people who use hammers on delicate equipment.

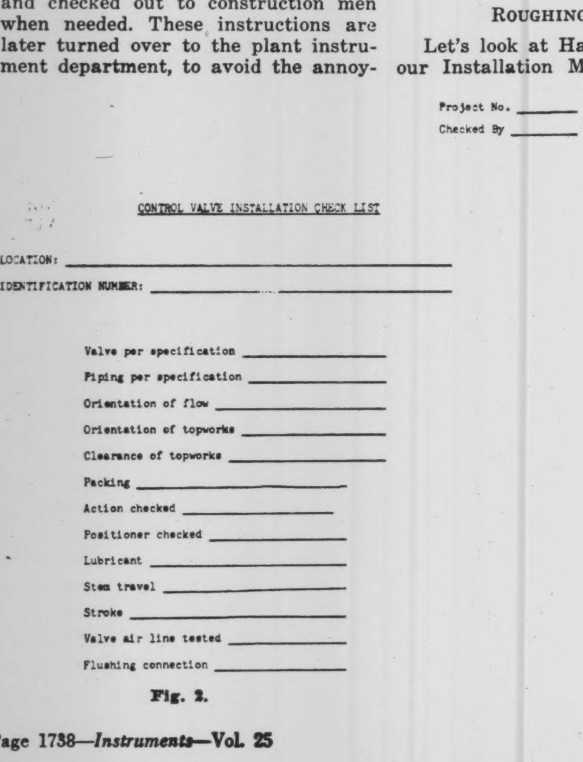
The roughing-in stage of installation is that in which the heavier pieces of equipment are put into place. At this time control valves and orifice flanges are installed in piping, the control board is set up, instrument air or hydraulic supply systems are erected, and in general the major pieces of control equipment are installed, but not interconnected. This stage is particularly important with large pipe, since mistakes at this point are very costly to correct.

### EXAMPLE OF FLOW CONTROLLER

As a specific example, consider the installation of the orifice flanges and the control valve of a flow controller. Fig. 2 shows a suggested check list for the installation of the flanges. The flanges are first located in the proper line, which is filled in by name. The instrument identification number is next filled in, which in this case is FRC-32.

The orifice flanges are then located at a point in the line to give the required straight length of pipe preceding and following the flanges. The actual straight length is filled in to keep this in mind. Next the orientation of the flanges is checked off as OK, after the specifications have been checked, and it has been decided that the connections should come out of the north side of the line, rather than the top or bottom.

The actual pipe inside diameter is then measured, marked down, and checked against the specification. In this case it is 2.91 inches upstream,



Project No. ________

Checked By ________

CONTROL VALVE INSTALLATION CHECK LIST

LOCATION: ________________________________

IDENTIFICATION NUMBER: ________________________

Valve per specification ____________

Piping per specification ____________

Orientation of flow ____________

Orientation of topworks ____________

Clearance of topworks ____________

Packing ____________

Action checked ____________

Positioner checked ____________

Lubricant ____________

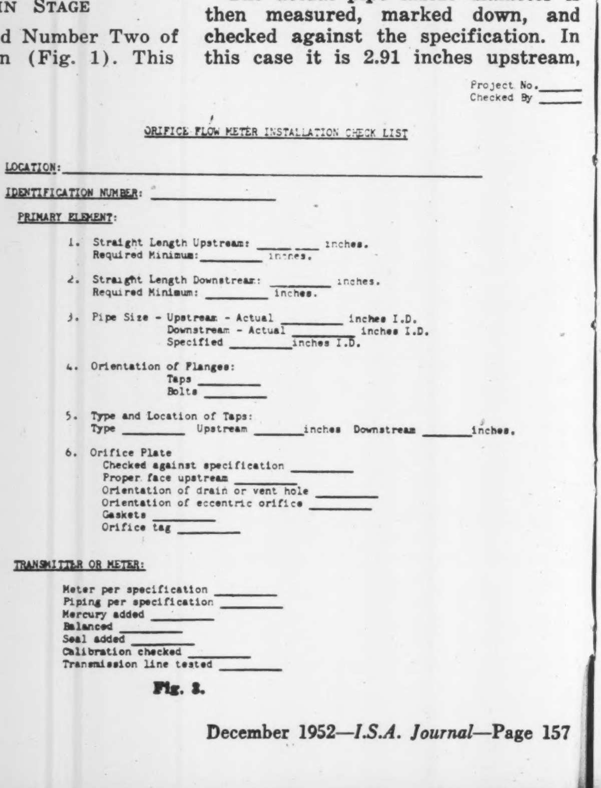
Stem travel ____________

Stroke ____________

Valve air line tested ____________

Flushing connection ____________

Fig. 2.



Project No. ______
Checked By ______

ORIFICE FLOW METER INSTALLATION CHECK LIST

LOCATION: ________________________________

IDENTIFICATION NUMBER: ____________

PRIMARY ELEMENT:

1. Straight Length Upstream: ________ inches.
   Required Minimum: ________ inches.
2. Straight Length Downstream: ________ inches.
   Required Minimum: ________ inches.
3. Pipe Size - Upstream - Actual ________ inches I.D.
   Downstream - Actual ________ inches I.D.
   Specified ________ inches I.D.
4. Orientation of Flanges:
   Taps ________
   Bolts ________
5. Type and Location of Taps:
   Type ________ Upstream ________ inches Downstream ________ inches.
6. Orifice Plate
   Checked against specification ________
   Proper face upstream ________
   Orientation of drain or vent hole ________
   Orientation of eccentric orifice ________
   Gaskets ________
   Orifice tag ________

TRANSMITTER OR METER:

Meter per specification ________
Piping per specification ________
Mercury added ________
Balanced ________
Seal added ________
Calibration checked ________
Transmission line tested ________

Fig. 3.

and 2.90 inches downstream. The flanges are now welded into place. Before the orifice plate is installed, the taps are checked for rough inside surfaces and for being open rather than obstructed.

Upon installation of the orifice plate, under "Orientation," "Proper Face Upstream" is checked off as OK, the square edge having been faced upstream. In this case, it is an eccentric orifice in a horizontal line to pass sediment, so the orifice is oriented on the bottom of the pipe, and so marked on the check list.

There is no drain hole in the plate, so the orientation need not be checked; hence the "None." After installation of the plate with gaskets, the plate is bolted in place, making sure that the gasket does not obstruct the orifice or taps, and that the orifice tag is present and plainly visible.

### CONTROL VALVE CHECK LIST

The flange check list then is put away for later reference, and a control valve check list is made out (Fig. 3). The "Location" is filled in for the valve, and the identification number, *FRC-32*, is marked again. The valve is checked against the specifications, and being of the right size, material, etc., "Specification" is marked OK.

The installation man then checks the orientation or flow, making sure that the plug side is upstream rather than the port side. The top-works of the valve is shown vertical on the drawings, so he mounts it in that position and at such a point in the line that it will not foul other parts of the plant, and so that it is accessible and may be readily moved.

He then checks off "Orientation of Top-works" and "Clearance of Top-works" as OK. Later he will check the lubricant, adjust the packing, adjust the positioner, check the action (air open or air close), stroke the valve to make sure no sticking occurs, and check the steam travel.

### LEVEL CONTROLLERS

As liquid level controllers are mounted, the installation man should give his attention to the location of the float center in relation to the normal liquid level and to proper shut off valve and equalizer piping. The location of level taps should be checked to avoid sediment, or water accumulation in the lower connections. Winter protection should also be considered. The relation of the taps to vessel internals, such as baffles, trays, packing, and wires should be inspected, since many a false level reading may be traced to improper location of the taps. The same applies to level connections subjected to impingement by an incoming stream.

### PREFABRICATED CONTROL PANEL

If a prefabricated control panel has been purchased, and the control house is ready for it, the installation instrument man should supervise the installation carefully to prevent damage to the finish or to the instruments. Since damage frequently results during storage, if the panel arrives ahead of time, it should be carefully protected by crating or fences until it is set in mounted prior to being connected, it place. Where instruments have been is well to lock them to avoid tingering, or "cannibalization" for parts.

### CONNECTION STAGE

Let's have another look at our Ideal Installer. This time look at Hand Number Three. You will observe the hand is not as long as the others, since this is the hand he uses during the connection stage of instrument installation, and he is particularly short-handed at this time.

The connection stage of instrument installation involves considerable attention to detail. At this time, the small piping, electrical and thermocouple leads, air supply lines, remote transmission lines, valve air lines, meter piping, gas analyzer sampling systems, and hundreds of odds and ends are installed.

### USE OF CONSTRUCTION DRAWINGS

The degree of help supplied by construction drawings varies at this stage. In some cases, the detail drawings are complete and accurate, which makes the job easy. In other cases, the drawings may be complete, but are taken "off the shelf" from other jobs, and do not apply closely.

With the rapid progress of instrumentation, this is too often the case, and it can result in severe headaches for the installation man, inasmuch as he must depend upon his judgment considerably, or must contact the instrument manufacturer or the instrument engineering department. Some firms rely heavily on the field man for installation details. This may be successful if the field man is of high caliber and keeps in contact with new developments. It may be disastrous otherwise.

### RUNNING TUBING & ELECTRIC LINES

Running of copper tubing lines during the connection stage requires a good deal of supervision by the instrument man to insure a neat job, and above all, to see that the lines begin and end where they should without being plugged or leaky. A rigorous leak-testing procedure should be followed. The Instrument Society of America is soon to release a recommended practices report on tubing testing.

As the electricians run thermocouple leads, they should be checked for proper termination by being "rung out" or by checking with an ohm-meter. A telephone set, sound-powered if possible, is of great help during this operation and during later testing and calibration. Other leads such as pH meter leads, resistance thermometer wires, alarm wires, and remote electric transmission systems are checked in a similar manner. All electrical leads should be inspected for suitable insulation for moisture conditions, and for special insulation as they pass through zones of high ambient temperature.

### FLOW AND PRESSURE CONNECTIONS

Flow meter piping requires careful supervision, particularly where an installation includes various forms of meters, such as a mixture of mercuryless differential types, mechanical mercury types, and rotameters. The sealing systems may vary from none at all, to very elaborate affairs, with consequent bewilderment of pipe fitters.

Meter piping, more than any other instrumentation, needs good installation drawings. Lack of standardization is apparent in this connection, and different firms may use piping differing widely in complexity or simplicity. The Instrument Society of America could well spend considerable effort on recommended installation drawings for various standard forms of meters, with manufacturers' cooperation.

Differential pressure and pressure instruments in catalyst service, or other powdered solids service require very careful checking of the purging connections and the method of installation. Fig. 4 shows a method of installation which has proved very effective in minimizing maintenance due to plugged taps.

The pressure transmitter is located *above* the taps, with purge at the taps. In this manner gravity helps to the result that the tap is plugged and keep the lines clear. Too often such an instrument is located for easy access rather than for proper operation, with the instrument must be cut out of service while the lines are blown back.

### CALIBRATION & TESTING STAGE

The fourth stage of instrument installation, the calibration and testing stage, is made considerably easier if the connection stage has progressed favorably. Our Ideal Instrument Installer can then use his fourth hand to advantage. This hand contains one finger with a small screwdriver tip especially adapted for loosening calibration link screws; one finger with a small dustpan to catch the screws before they drop on the floor; and two fingers permanently crossed in hopes that the instrument will check without messing with it.

### CHECKING TRANSMITTERS

Transmitting instruments are best checked for output versus the variable they transmit. For example, a pressure transmitter may be checked for air output by means of a mercury manometer on the transmitted air line, with a portable oil pump and standard test gauge connected to the pressure element. The receiver is then checked

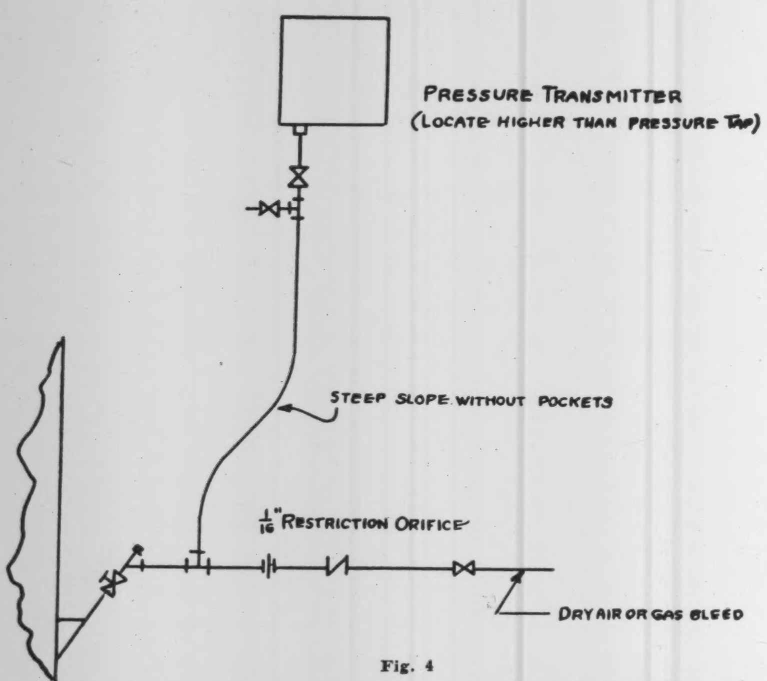

PRESSURE TRANSMITTER
(LOCATE HIGHER THAN PRESSURE TAP)
STEEP SLOPE WITHOUT POCKETS
1/16" RESTRICTION ORIFICE
DRY AIR OR GAS BLEED

Fig. 4

for calibration by applying air to it with the mercury manometer reading over the transmitted air range.

The transmission line is then connected, and the receiver is checked against the oil pump and test gauge. If the calibration agrees, it indicates that the transmission tubing is free of leaks. A low reading on the receiver indicates a leak in the transmission tubing.

Another system of checking is to connect the transmitter and receiver the transmitter or receiver linkage to to the transmission tubing, apply pressure to the pressure element with the oil pump and gauge, and change either make the two agree. This is not to be recommended, since either the transmitter, the receiver, or both may end up with a non-standard calibration of, say, 2 to 14 pounds per square inch of air over the transmission range rather than 3 to 15 pounds per square inch.

This has the disadvantage that either the transmitter or the receiver cannot be bench-tested and replaced without a complete calibration through the entire system. Further, a leak in the transmission line will then be compensated for by a change in the calibration linkage, rather than by repairing the link. Obviously a change in leakage of the tubing will result in a change in calibration.

### CHECKING PYRAMETERS & CONTROLLER OPERATION

Electrical temperature instruments are checked against portable instruments, and the calibration is adjusted where required. Needless to say, the accuracy of the portable instrument, and the checking procedure should be unquestionable before factory calibrations are changed. A good procedure is to check the instrument at the control board with the regular extension wire disconnected, and then to recheck the calibration by connecting the portable instrument at the field termination of the extension wire. A difference in calibration will often uncover such troubles as reversed leads at splices, improper extension wire materials, or insulation failure.

The direction of operation of controllers should be carefully checked against the specifications to see that, for instance, a rise in temperature will cause a control valve to close, where closing will tend to reduce the temperature. Reversed operation of instruments is very confusing to operators, so that serious consequences could result before the reversal is discovered.

### OTHER FINAL CHECKS

At the same time as the direction of operation of the instrument is checked, the valve or other operator may be put through its paces to check for sticking, improperly adjusted positioners, and to see that the controller is working the right valve. Also at this time, controller adjustment may be tested to see that proportional band and reset are functioning as intended. The controller may then be set at an estimated proportional band or reset rate. These adjustments will be corrected later during the start-up if it is found necessary.

As each instrument is checked through from plant to control board, it should be marked with a tag or label to indicate that it has received attention. The instrument man doing the testing should initial the testing record. This will tend to make for more careful attention, and make omissions less likely. Nameplates may be checked for proper labelling of instruments at this time, and meter factors should be put on flow meters for the convenience of plant operators, if they are not already a part of the nameplate.

Preparatory to start-up, chart clocks should be started, pens inked, air and electricity cut in, meters should be sealed and balanced, and potentiometers or other electrical instruments balanced where required.

### START-UP STAGE

Our Ideal Instrument Man's fifth hand is removable, so that he can leave it in one place and go somewhere else during the start-up stage, since he must generally be in two places at one time during the plant start-up.

After pumps have been run in, valves should be opened to clean out rocks, welding slag, scale, and dirt where valve action indicates this is necessary. Any temporary screens used to protect flow elements, valves, or pumps should be removed after a proper period of operation.

The start-up stage is a hectic period which may be made considerably easier if representatives of the various instrument companies can be present to give advice and help. Their activities should be coordinated with those of the plant instrument department, the installation instrument engineer, and the plant operating personnel to avoid confusion.

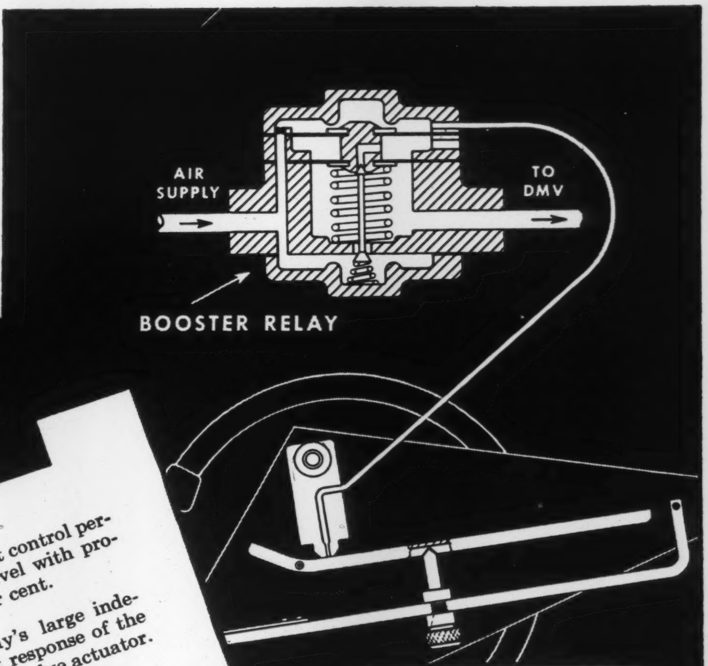
Each person's responsibility must be clearly understood. For instance, one will be responsible for cutting in service liquid level controllers and valves, one will give meters attention, and so on. In the interests of safety and good relations, the operator in charge of the plant should be consulted when any change is made, or when an instrument is to be cut in or out of service for repair or adjustment.

When the plant or a particular part of a plant has lined out sufficiently, the proportional band, reset, or derivative adjustments are dressed up to eliminate cycling, drift, or instability of controllers.

The start-up period is the eventual showup of errors in engineering, drafting, and construction. The field instrument engineer can perform a valuable service if he writes a report of troubles encountered, and how he thinks they can be avoided in future installations. The manufacturer should be advised of any difficulties encountered with his instruments, and of any suggestions for improvement of the instrument to correct the difficulty.

All suggestions should be made in the spirit of constructive criticism to correct future difficulties, and should be done in a diplomatic way to avoid unnecessarily injured feelings.

# It's the BOOSTER RELAY that gives this Pressure Controller these 4 exclusive features



1 **It's accurate** . . . provides closest control performance, including full valve travel with proportional band set as low as 1 per cent.

2 **It's fast** . . . the booster relay's large independent air supply permits fast response of the valve, regardless of the size of the valve actuator.

3 **It's sensitive** . . . responds to the slightest pressure changes.

4 **It uses a minimum amount of air** . . . use of booster relay permits small nozzle which requires only 0.1 scfm under steady state pressure conditions.

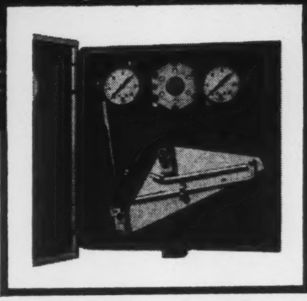
## *New Honeywell Pressure Pilot*

In ruggedness, too, the Pressure Pilot leads the way. It goes anywhere . . . takes the toughest field conditions in stride. It makes a fitting companion, of course, for Honeywell's Series 700 valve line.

It has every other feature you need: easy adjustment of set point, positive overload protection, simple construction, quick reversibility, universal mounting; and best of all, the cost is surprisingly low.

Our nearest engineering representative will be glad to demonstrate the Pressure Pilot for you right in your plant. Call him today . . . he is as near as your phone.

Minneapolis-Honeywell Regulator Co., *Industrial Division*,
1908 Windrim Ave., Philadelphia 44, Pa.



*Internal view at top shows arrangement of elements depicted in diagram. External view at bottom shows Pressure Pilot with door closed.*

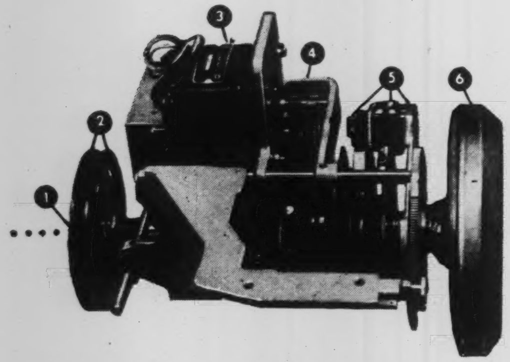
MINNEAPOLIS
**Honeywell**
VALVE PRODUCTS
*First in Controls*

● *Important Reference Data*
**Write for new Bulletin 16-1, "Honeywell Pressure Pilot."**

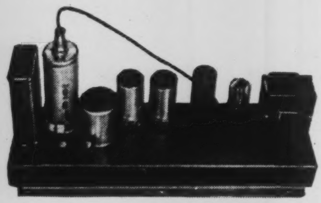
# POWER IS PERFORMANCE

## ... and Speedomax Instruments lead with "huge" 12-watt balancing motors!

1. Center line of slidewire and shaft
2. Control cams
3. Balancing motor
4. Spring-loaded no-backlash drive
5. Control slidewires
6. Measuring slidewire

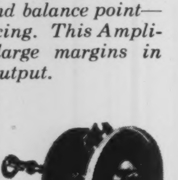


*This partially dis-assembled view of Speedomax shows its two-phase Balancing Motor and gears, with a typically "heavy" load of slidewires and contacting cams for signal and control devices. Several more cams, etc., can be added if necessary; only practical limit is physical space on shaft. Smoothness in operating many contacts is an outstanding Speedomax ability.*



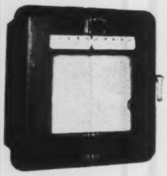
*Amplifier which feeds the Speedomax balancing motor the controlling half of its power. Torque gradient is especially high where needed most—around balance point—for prompt, positive balancing. This Amplifier leads its field by large margins in sensitivity and in power output.*

*Good circuit engineering shows in this Slidewire's non-inductive wiring and in the absence of any flexible leads which might form inductive loops.*



CAREER OPPORTUNITIES AT L&N

Expansion program of this long-established firm has many features to attract outstanding recent graduates in engineering and science. Opportunities are in sales field engineering, product and application engineering, research, advertising, market development. Widely-respected policies assure recognition of progress and achievement. Address Personnel Manager for preliminary interview at nearest of 17 L&N offices.



• Power underlies good performance, in instruments as in automobiles, machine tools or rolling mills. That's why L&N engineers insist that an automatic instrument should operate as positively and promptly as any other high-grade machine.

Even the first null balance potentiometer Recorder we built, back in 1911, which went to a steel mill, had a 110-volt motor instead of a spring drive to run its balancing mechanism, chart and signalling contacts. And, while its pioneering of balance-method measurement attracted the most attention, its ample power certainly helped establish L&N Recorders as the coming idea in process Instrumentation.

Power has done the same for Speedomax instruments. Twenty years ago, Speedomax pioneered the electronic idea of measurement—in a husky, powerful piece of equipment. Today's models have from 2 to 4 times more power in their balancing motors than any other current models of electronic controllers, recorders or indicators.

This power means superior performance in both load-carrying and speed. Load-carrying ability applies especially when the motor operates, in addition, an unusual number of contact devices. But even the most usual Speedomax jobs—automatic control, for instance—can call on the instrument's power for high operating speed in handling the normal number of control devices. The strong, wide-faced, rigidly-mounted cams and gears so typical of Speedomax instruments start moving instantly, move rapidly and stop dead still without coast. Signalling and control action is correspondingly crisp and precise.

Speedomax for industrial use is described in Catalog ND46 (1); additional information for unusual applications is given in Technical Publication ND46(1). Either will be sent on request by our nearest office or from 4955 Stenton Ave., Philadelphia 44, Pa.

**LEEDS LN NORTHRUP**

instruments automatic controls • furnaces

Jrl. Ad. ND46(8)

JOURNAL of the
Southern California Meter Association

President: F. M. Partridge
Auditor: C. B. McKinney
Vice-President: James A. Serey, Jr.
Past President: H. C. Bennett
Secretary-Treasurer: Geo. H. Forster, Jr., 2916 Eucalyptus Ave., Long Beach 6, Calif.

# ELECTRONIC RECORDERS

By EMORY FERREE
Minneapolis-Honeywell Regulator Co.

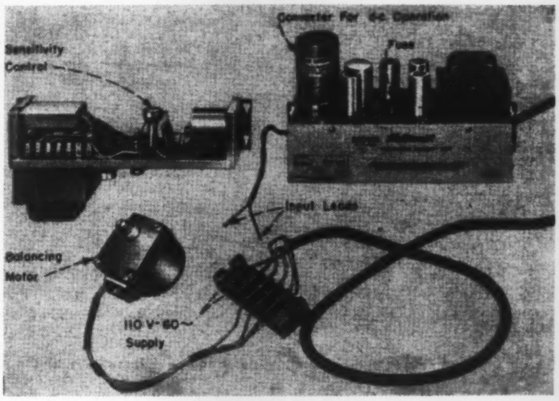

Converter For d-c Operation
Fuse
Sensitivity Control
Input Leads
Balancing Motor
110 V-60~ Supply

Fig. 1. Components of an electronic recorder.

**Important features of electronically balanced recorders are (1) types, (2) standardization methods and circuits, (3) spans, and (4) types of bridges. Their use is expanding in electrical measurements and specialized measurements.**

ELECTRONICALLY balanced recorders have become familiar instruments in most of the process-industry and research laboratories in the United States because of their inherent advantages—(1) high accuracy, (2) large force available to operate the pointer and controls, and (3) usefulness in any position, allowing them to be used in mobile and airborne applications. The instruments are available in many shapes—strip-chart recorders, circular-chart recorders, circular-scale indicators, and multipoint precision indicators.

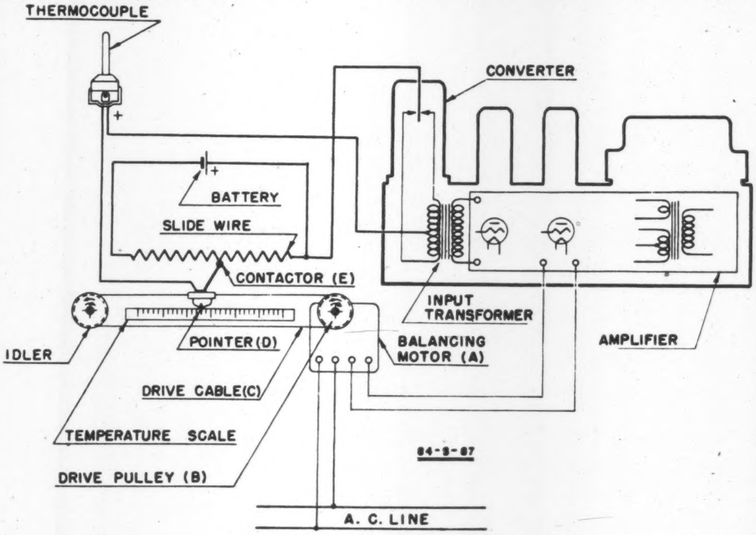

THERMOCOUPLE
CONVERTER
+
BATTERY
SLIDE WIRE
CONTACTOR (E)
INPUT TRANSFORMER
AMPLIFIER
IDLER
POINTER(D)
BALANCING MOTOR (A)
DRIVE CABLE(C)
TEMPERATURE SCALE
DRIVE PULLEY (B)
84-3-87
A. C. LINE

Fig. 2. Basic potentiometer circuit.

Fig. 1 shows the electronic system. The amplifier receives a small electrical error signal, amplifies it, and controls the motor which drives both a recording pen and a variable resistor, inductor, or capacitor to restore the electrical balance. The amplifier is an a-c. unit that controls the motor direction by shifting the phase in the starting winding of the motor. When the error signal is a d-c. signal, the input is converted by a polarized-reed vibrator. The black cylindrical object on the top of the amplifier chassis is the vibrator, or convertor.

Amplifiers are available in several sensitivities. The most common amplifier starts the motor with an input signal of 3 microvolts. Another type, which is 40 times as sensitive, starts the motor with an input voltage of approximately 0.08 microvolt.

### POTENTIOMETER CIRCUITS

Electronically balanced instruments are of two types—potentiometer and bridge. As most electronically balanced instruments are potentiometer types, the term "electronic potentiometer" is

*December Meeting*: Thursday, the 15th, Rio Hondo Country Club, Downey, Calif.
*Feature*: Mr E. A. Bianchi, Director of Engineering of the Mason Neilan Regulator Company, will present a paper on "Displacement-Type Liquid-Level Controllers and Their Application."

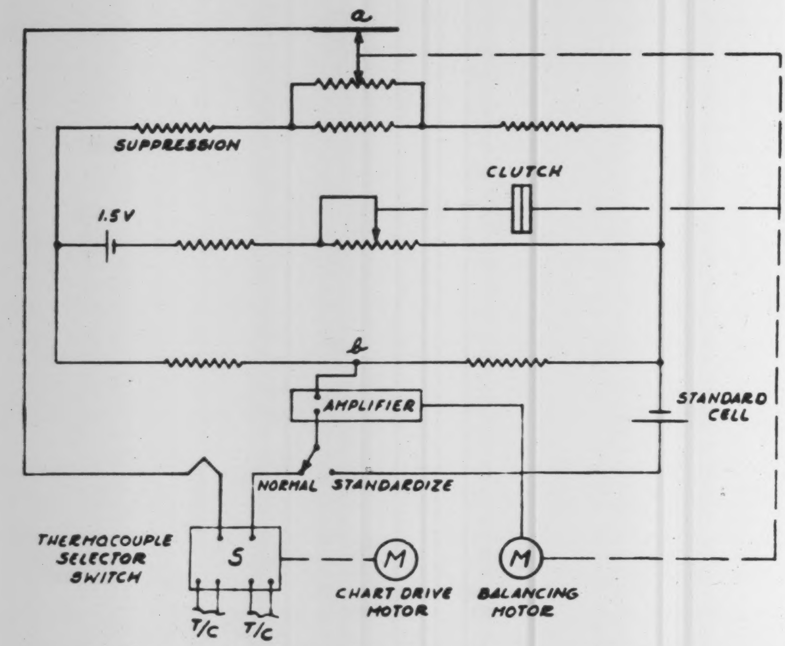


**Fig. 3. Standardization circuit, showing separate chart drive and balancing motors.**

commonly used to identify all instruments of the electronically balanced type. The potentiometer type is a voltage-measuring device whereas the bridge type is a resistance- or impedance-measuring instrument.

The potentiometer circuit is shown in Fig. 2. A battery voltage is impressed across the slidewire, which is a precision adjustable resistance. The thermocouple generates a small unknown voltage. The amplifier is in series with the thermocouple and with the voltage which appears between one end of the slidewire and the movable contact. If the two voltages are not equal, the motor operates in the proper direction to restore the balance. As a pointer is attached mechanically to the movable contact, the scale can be calibrated in terms of voltage or temperature.

### STANDARDIZATION

As the accuracy of the measurement is a function of the accuracy of the voltage impressed across the slidewire, this voltage is periodically tested and adjusted ( Fig. 3). A switch transfers the amplifier from the measured voltage (the slidewire contact voltage at *a*) to a voltage from a standard cell. This cell delivers a precise voltage but is not capable of delivering the current required by the bridge circuit. Any difference in these voltages causes the amplifier to drive the motor, the slidewire contact, and its associated pointer until the two voltages are equal.

In manual standardization, the operator observes the pointer motion and adjusts the rheostat in series with the 1.5-volt dry cell until the motion stops. More commonly, a clutch is operated simultaneously with the standardizing switch so that the motor adjusts the rheostat automatically. If the standardizing switch and clutch are operated manually, the standardization is termed "semi-automatic" standardization. If they are operated periodically by a timer, it is termed "automatic" standardization.

In some control applications the pen and pointer cannot be allowed to move during the standardizing period even though the motion is slight. To prevent pointer motion, the motor driving the slidewire and pointer is disconnected and the amplifier is connected to a second motor which operates the battery-adjusting rheostat.

In some precise applications it is necessary to use one amplifier and motor for the measuring circuit and a second amplifier and motor for the standardizing operation. This permits continuous standardization.

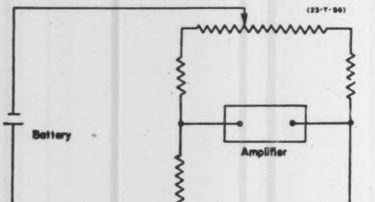


**Fig. 4. Basic d-c. Wheatstone bridge circuit with resistance thermometer.**

### RANGE

The span of the instrument is changed simply by changing the shunt resistor across the slidewire. The electrical zero point can be altered by changing the resistors in series with the slidewire. If desired, variable or tapped resistors can be furnished so that the range can be changed in a few seconds. For example, the span can be set to anything from 1 to 50 millivolts and the zero can be from minus 50 to plus 50 millivolts (suppression). This type of instrument is useful as a laboratory instrument.

### THERMOCOUPLE MEASUREMENTS

One of the most common uses of a potentiometer is temperature measurement by thermocouple. The voltage generated by the thermocouple depends on the difference in temperature between the hot and cold ends of the thermocouple. To counteract changes in temperature at the cold junction—which is the point where the thermocouple wires join the copper wires of the instrument circuit—a resistor (the lower left resistor in Fig. 3) is made of an alloy which changes resistance with changes in temperature. This resistor continuously resets the electrical zero of the bridge to compensate for the difference in potential caused by changes in cold-junction temperature. The cold junction is located inside the compensating resistor to assure that both are always at the same temperature.

The compensator and cold junction usually are in the recorder case; however, for applications where a large number of thermocouples are located at a distant point, the compensator is located near the thermocouples to conserve alloy wire. Copper wire then can be used between the cold junction and the recorder.

The thermocouple selector switch can be used in conjunction with appropriate mechanical printing mechanisms to record up to 300 temperatures on one chart.

*A-c. potentiometers* have no convertor or standardizing circuit. However, they require a precise external voltage.

### BRIDGE RECORDER

The second most popular circuit is the automatically balanced Wheatstone bridge. Fig 4 shows a resistance ther-

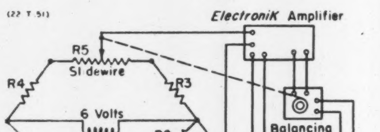


**Fig. 5. Conductivity-measuring circuit using a-c. Wheatstone bridge.**

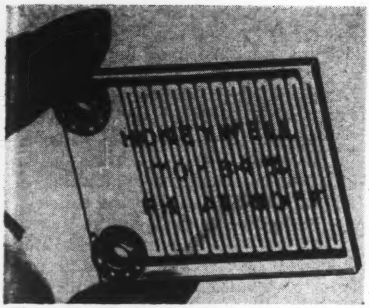


Fig. 6. Gold-leaf grid mounted on plastic and coated with a chemical film sensitive to moisture.

mometer in a Wheatstone bridge. A change in temperature changes the resistance of the bulb, causing a voltage to appear across the amplifier. A balancing motor repositions the slidewire contact to balance the bridge, thus reducing the voltage across the amplifier to zero. The bridge is balanced when the *ratio* of the upper left resistor to the lower left resistor equals the *ratio* of upper right resistor to lower right resistor. As only ratios are involved, the bridge is independent of supply voltage.

The resistance bulb may be located at a distance from the battery because one wire to the bulb is in the right half and the other wire is in the left half of the bridge. Therefore, the resistance *ratio* is not upset and the circuit is independent of location of the resistance bulb. Resistance bulbs are available in several materials—platinum, copper, nickel, and ceramic thermistors.

The bridge circuit can be used for measuring all types of resistance changes. For example, the resistance change of a strain gage can measure pressures, deflection force, load, etc. Strain gages are fast in response; when used with high-speed electronically balanced recorders they are suitable for studies involving fast response.

The Wheatstone bridge circuit may be energized by either alternating or direct current. Direct-current systems are not subject to phasing problems and are more easily damped for high-speed response. However, many applications require a-c. circuits, particularly for electrochemical measurements. For example, if a.c. were not used in the conductivity-measurement circuit of Fig. 5, the electrodes soon become polarized and cause errors. Conductivity recorders are useful in the manufacture of acid, treatment of boiler water, measurement of salt solutions, etc.

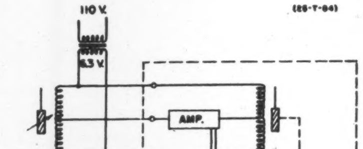


Fig. 7. Inductance bridge.

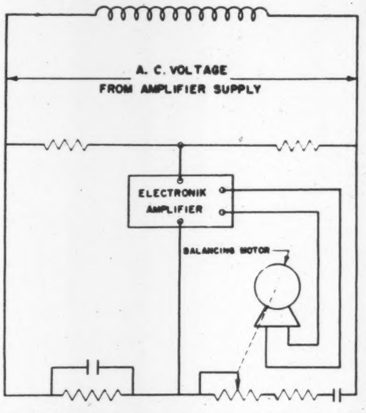


Fig. 8. Frequency recorder using a Wien bridge.

The Honeywell relative-humidity recorder (Fig. 6) also requires an a-c. bridge for the same reason. The principle of operation is the measurement of resistance of a gold-leaf grid mounted on a plastic coated with a chemical film that is sensitive to moisture.

### Inductance Bridge

The rebalancing unit can be a variable inductor (Fig. 7). In this circuit the transmitter, which may be a flowmeter, moves the iron armature at the left. This increases the impedance in one half of the transmitting coil and reduces the impedance in the other half, causing a voltage to appear across the amplifier. The balancing motor then moves the iron armature in the recorder to rebalance the inductance bridge. By rectifying the error signal, inductance bridge circuits can be powered from other than line frequencies, thus extending their usability to inductance tranducers which are small in size.

### Wien Bridge

Fig. 8 shows a frequency recorder that uses a Wien bridge. One half of the bridge has a resistor and a capacitor in parallel; the other half has a resistor and a capacitor in series. Therefore, the impedance of each side is affected differently by frequency and there is only one frequency at which the impedances are equal. A change in frequency thus causes current to flow through the amplifier, which causes the motor to reposition the slidewire to equalize the impedances in the two halves of the circuit. The most common use of this instrument is to record variations in generated frequency at power stations. The instrument usually is supplied with a range of 59 to 61 cps. on a 12-inch chart and is sensitive to less than 1/100 cps.

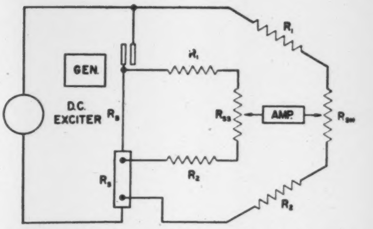


Fig. 9. Temperature recorder for a rotor of an electric generator. $R_1$ and $R_2$ are instrument resistors; $R_F$ is rotor resistance; $R_S$ is shunt resistance; $R_B$ is bus-wire resistance; $R_{SS}$ is straight slidewire; $R_{SH}$ is helical slidewire.

### Kelvin Bridge

Another instrument used in the electrical generating plant is the recording Kelvin bridge, which is used to record the average rotor-field-winding temperature. The field winding is used as a resistance thermometer (Fig. 9). The generator field supply, which is several hundred volts and several hundred amperes, is used in place of the usual dry cell. The resistance of the winding is compared with the resistance of a standard meter shunt. The second slidewire compensates for the resistance of the wire connecting the collector ring with the meter shunt. The measuring circuit is fused and insulated for high voltage.

### Special Problems

Recorders are available with spans of the order of 100 microvolts full scale. The circuit resistors are contained in a thermal shield, and a second amplifier

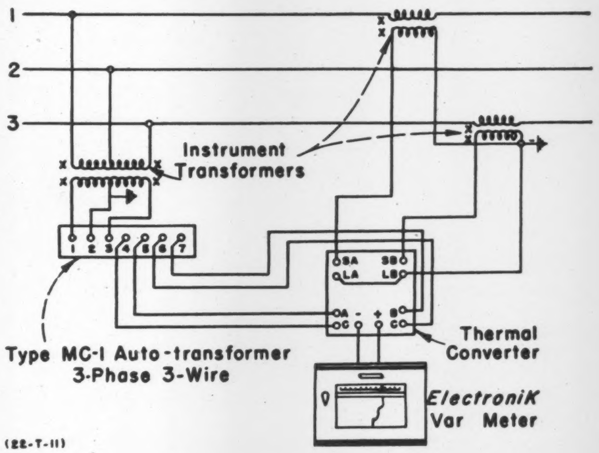
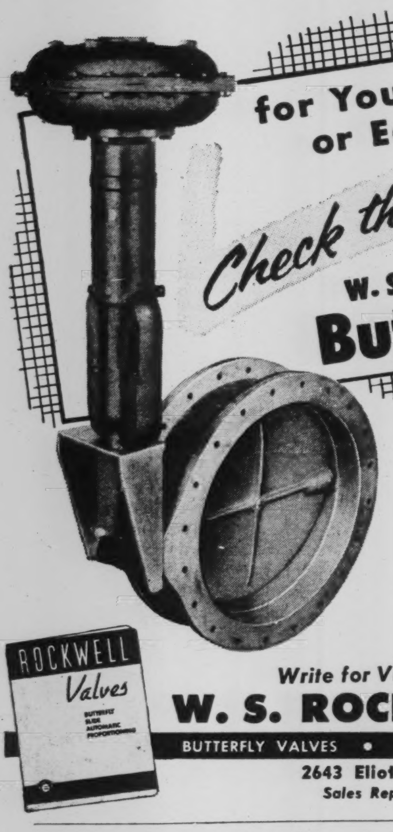


Fig. 10. 3-phase connection for recording Vars.

for Your Pipe Lines or Equipment

*Check these Advantages of*

**W. S. ROCKWELL Butterfly Valves**



- ★ Minimum pressure drop — when fully open, valve practically as free as pipe itself.
- ★ Uniform, quick control manually or automatically.
- ★ Positive shut off—commercial, drip tight or air tight.
- ★ Pressures to 600 p.s.i. Temperatures to 2000° F.
- ★ Made of any metal or rubber-lined.
- ★ Sizes—1" to 72" and larger.

*Write for Valve Catalog*

**W. S. ROCKWELL COMPANY**

BUTTERFLY VALVES • SLIDE VALVES • AUTOMATIC VALVES

2643 Eliot Street • Fairfield, Conn.
*Sales Representatives in Principal Cities*

**INSTRUMENT ENGINEER**

*for*

**NATIONALLY-KNOWN INDUSTRIAL LEADER**

A graduate engineer with 10 years practical and theoretical experience in instrumentation will find this an excellent opportunity with a young and expanding division of a leading company.

Should have broad background in electronic controls, design and development of electronic circuits and temperature, pressure, electrical and hydraulic instrumentation.

Position is in Cincinnati area, in a modern plant. Advancement opportunities and many benefits.

**Send complete resume to box 228.
Instruments Pub. Co.,
921 Ridge Ave., Pittsburgh 12, Pa.**

**ENGINEERS**

The Electric Auto-Lite Company offers a fine opportunity to graduate Mechanical or Electrical Engineers with several years instrument design experience to become fully fledged development engineers with commensurate income.

Our products are used by all of the major industries of the nation and the world. There are openings in our Central Engineering Department, Toledo, Ohio, and at our Instrument Division in Wisconsin.

Men with initiative and ability and an urge to reach the top of their profession should contact Mr. P. G. Robinson, Personnel Director, The Electric Auto-Lite Company, Toledo 1, Ohio, for an interview.

is used for continuous standardization. Special precautions in shielding and soldering must be used in this type of instrument.

Another application of low-current measurement is pH measurement, which is used in many chemical processes. The pH system uses a set of platinum and calomel electrodes which create a potential proportional to the concentration of hydrogen ions in the solution. The output of the electrodes is amplified by a special amplifier and is recorded on a standard d-c. potentiometer. Similar equipment is used for measurement of oxidation-reduction potentials.

An optical system is used in the Beckman oxygen analyzer. A mirror attached to a dumbbell-shaped suspension deflects a light beam so that it falls on two photocells. The paramagnetic characteristics of oxygen are used to deflect the mirror, causing more light to fall on one photocell, less on the other. The unbalance drives the recorder in one direction or the other. As the recorder moves it changes the voltage on a set of electrodes which exert an electrostatic force on the dumbbell, driving it back into the magnetic field. When equilibrium is restored, the balancing motor stops and the recorder reads the oxygen.

Large a-c. voltages, currents, power, and vars (volt-amperes reactive) can be measured by use of a thermal convertor and phase-shifting transformer. Fig. 10 shows a 3-phase connection for recording vars. Potential transformers and current transformers are used to reduce the power into the convertor to less than 1000 watts per element. If it is desired to record watts rather than vars, it is necessary only to use standard potential transformers rather than the phase-shifting transformer. If only voltage or current is to be measured, a single transformer and a single-element convertor is all that is required.

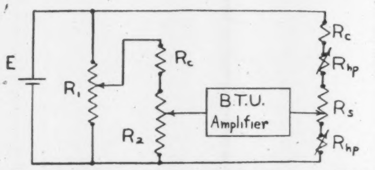


**Fig. 11. BTU meter. $R_1$ is flow transmitter slidewire. $R_2$ is differential-temperature transmitter slidewire. $R_C$ are current limiters. $R_S$ is BTU-recorder slidewire. $R_{hp}$ is adjusting resistor.**

Fig. 11 shows how bridge circuits may be used as computers. A flowmeter and a differential-temperature recorder are equipped with repeater slidewires ($R_1$ and $R_2$). Slidewire $R_S$ in the BTU meter is moved (and the pen records) to balance out the *product* of $R_1$ and $R_2$, giving total BTU's of heat. Circuits can be arranged to add, subtract, average, take ratio, divide, square, and extract square root. In conjunction with other basic equipment, electronic recorders can be used to record hundreds of different variables, which can be transmitted any place that telephone wires can go.

# *Initial Announcement*

# THE 1954 INSTRUMENTS INDEX

## *Publication date, July 1953*

CIRCULATION: *The* 1954 *Instruments Index* will be sent to 20,000 users of instruments and devices for measurement, inspection, testing and control. These are the 20,000 most important men who buy, install and maintain instrument and control devices.

COMPLETE HORIZONTAL COVERAGE of the men who buy and specify instruments and controls in every major instrument-using company. *The Instruments Index* reaches the largest number of potential instrument buyers at the lowest cost.

PRODUCTS ADVERTISED are scientific and industrial instruments; automatic electrical, mechanical, hydraulic, electronic and pneumatic controls; electric and electronic instruments; testing machines and devices; inspection devices and gages; control valves; relays; timers; laboratory and glass apparatus; etc.

CLOSING DATES: Copy to prepare, all details must be in our Pittsburgh Office not later than April 1st. Layout and copy will be sent to the advertiser for his OK and also final proofs.

| | |
|---|---|
| Copy to set | May 20th |
| If no proof required | May 25th |
| Complete plates | June 1st |
| Inserts | June 15th |

Advertisers' Names **Boldface** in Descriptive Directory: Advertisers in *The Instruments Index* will have their names in boldface type in the Descriptive Directory Section and reference will also be made to the page number (s) on which their advertisement(s) appear. This gives to the individual seeking information the two vitally important elements of the *Index*—1. Where he can buy it, and 2. Technical data, when he turns to the page to which he is referred.

A NEW FEATURE, greatly increasing the inquiry-producing power of this buying directory, will be the addition, in the alphabetical list of manufacturers, of: (1) Names of cities where the company has branch offices; and (2) Names and cities of the company's Authorized Agents.

RATES and Mechanical Requirements: Advertisers will be entitled to the rate earned in the 12 regular issues of *Instruments* or to the rate they earn in *The Instruments Index*, whichever is most advantageous. Space used in the *Index* will not help earn a rate in the regular issues of *Instruments*. But the rate earned in the regular issues will determine the rate for the *Index*.

### *INDEX* RATES

| | | | |
|---|---|---|---|
| 1 Page | $330.00 | 4 Pages | $1232.00 |
| 2 Pages | 624.00 | 6 Pages | 1716.00 |
| 3 Pages | 939.00 | 8 Pages | 2200.00 |

All AAAA Standard Colors: Red, blue, yellow, orange, green, $100.00 per page for any one color. Matched colors $120.00 per page for any one color. Rates for metallic inks quoted on request. Bleed Pages: per page, extra $75.00

Rates for Complete Inserts:

| | |
|---|---|
| 2 Pages (backed up) | $ 530.00 |
| 4 Pages (backed up) | 1150.00 |
| 8 Pages (backed up) | 2050.00 |

### REGULAR *INSTRUMENTS* PER-PAGE RATES

| | | | |
|---|---|---|---|
| 1 Page | $360.00 | 6 Pages | $314.00 |
| 2 Pages | 354.00 | 8 Pages | 302.00 |
| 3 Pages | 344.00 | 9 Pages | 297.00 |
| 4 Pages | 338.00 | 12 Pages | 275.00 |

Mechanical Requirements

| | Width | Depth | Width | Depth |
|---|---|---|---|---|
| 1 Page | 7 | 10 | —— | —— |
| 2/3 Page | 4½ | 10 | —— | —— |
| ½ Page | 3-5/16 | 10 | 7 | 4⅞ |
| ⅓ Page | 2-1/6 | 10 | 4½ | 4⅞ |
| ¼ Page | 3-5/16 | 4⅞ | —— | —— |
| 1/6 Page | 2-1/6 | 4⅞ | —— | —— |

All halftones should be 110 screen.
Page trim size—8¼" wide × 11¼" deep
Bleed size—8⅜" wide × 11½" deep
Actual type measurement inside border.

INSERTS (Letterpress): Rates for complete inserts apply on inserts which are ready for binding when received. Before making plates or ordering printing please check with the Pittsburgh Office as to number of pages, quantity required, trim size. Maximum acceptable weight 100 lb. coated, 25 by 38 inch basis, or equivalent.

REPRINTS: Regular run of book stock will be used unless special stock is supplied by the advertiser. For reprint costs write Pittsburgh Office.

## INSTRUMENTS PUBLISHING COMPANY

**921 Ridge Ave., Pittsburgh 12, Pa.** **Telephone: Fairfax 1-0161**

For further details write or phone your nearest *Instruments* Representative

ALTADENA, Calif.—M. D. Pugh, 2721 N. Marengo Ave., Sycamore 7-2894

BOSTON—James Condon, 36 Myrtle St., Lafayette 3-0829

CHICAGO—Harold W. Haskett, Room 615, 360 N. Michigan Ave., Andover 3-4299

NEW YORK—Richard Rimbach, Jr., Room 349, 551 Fifth Ave., Murray Hill 2-0821

PHILADELPHIA—William J. Gallagher, Room 1102, 3701 Broad St., Baldwin 9-9940

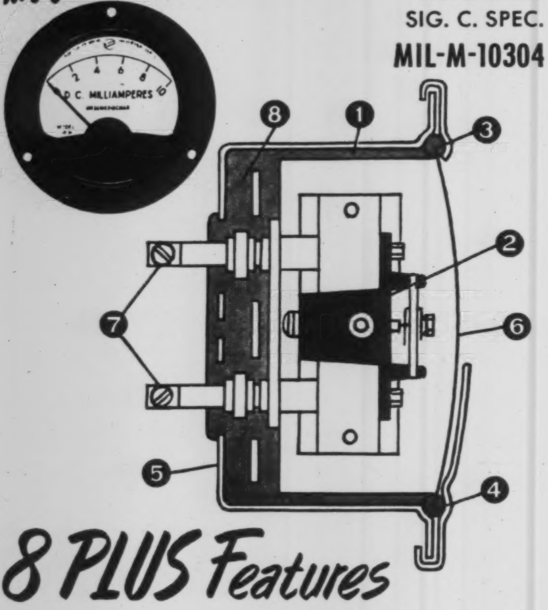
PITTSBURGH—C. F. Goldcamp, 921 Ridge Ave., Fairfax 1-0161

ST. LOUIS—James R. Wright, 411 North Tenth St., Chestnut 1965

**Available NOW!**

**RUGGEDIZED METERS**

...TO MEET
SIG. C. SPEC.
MIL-M-10304



**8 PLUS Features**

**Extra "Ruggedized" Features**

① Meter movement completely shock-mounted and housed in rubber-lined case.

② Meter movement supported by die-cast frame for greater strength and increased accuracy.

③ Observation window rubber grommeted and sealed to rubber lining of case—providing hermetical seal of high dielectric materials.

④ Non-rigid mounting of observation window with rubber grommet increases resistance to shock.

⑤ Each meter designed and built by SUN to highest quality and precision standards.

**Extra Installation Advantages**

⑥ Slight convexity of observation window reduces chance of accidental breakage during installation or shipment.

⑦ Terminals side-tapped and provided with tinned binding screws to facilitate wiring with or without wire lugs or by pressure, soldering or both.

⑧ Breakage or damage in wiring is reduced through non-rigid mounting of terminals and use of flexible interior conductors.

Building rugged electric meters is not new to SUN . For over 20 years, the automotive industry has depended on SUN as one of the largest "D'Arsonval-type" meter manufacturers—to produce rugged, tough meters that will stand up under the abuse and rough handling of portable field instruments used in automotive repair work. SUN "Ruggedized" Meters not only meet Specification MIL-M-10304 (Sig.C.)—but also embody many *plus* features that make installation easier, faster and help prevent assembly or shipping damage. Complete data bulletin on SUN "Ruggedized" Meters available on request.

*SUN "Ruggedized" Meters are available as D-C Volt Meters, Ammeters, Milli-ammeters and Micro-ammeters and also may be ordered as rectifier type A-C instruments.*

**SUN ELECTRIC**
**CORPORATION**
6385 AVONDALE AVE., CHICAGO 31, ILLINOIS

6060E

## RIVER POLLUTION

*Continued from page 1716*

concentration. For example, few fish will live where 1 ppm. of cyanide ion is present, and some succumb at a third of this concentration.

### POLLUTION CONTROL

The measures that can be used to control pollution are of two broad and more or less interdependent kinds. The first method includes all the precautions that should be taken to reduce pollution at its source. The second is appropriate treatment of residual wastes. Instrumentation can be used effecively in a variety of ways.

Pollution from land erosion can be minimized by contour plowing, planting steep banks with strongly rooted vegetation, and restoration of forest cover. Urban drainage ordinarily cannot be controlled. Pollution from domestic sewage can be reduced to any desired degree by installing suitable treatment facilities; instrumentation can be helpful in these operations. The volume and composition of industrial wastes, although highly variable, are subject to better control than natural wastes, and the major emphasis on applications of instrumentation can be directed usefully to this field.

Stream-pollution problems arise almost wholly from the discharge of water-borne wastes. The condition of the receiving water is therefore a function of the kind, concentration, and total amount of pollutional material in relation to the capacity of the stream for self-purification. A variety of instruments, many evolved from laboratory analytical devices, is available for measuring certain important characteristics of waste water, and of natural streams and lakes. Although commercial instruments for measuring every significant variable are not yet being marketed, it is probable that research will eventually succeed in devising practical devices for complete control of waste water.

*Control at Source*

Pollution can best be abated by preventing water-borne waste. This means careful control of manufacturing operations to keep discharges to the minimum consistent with satisfactory product quality.

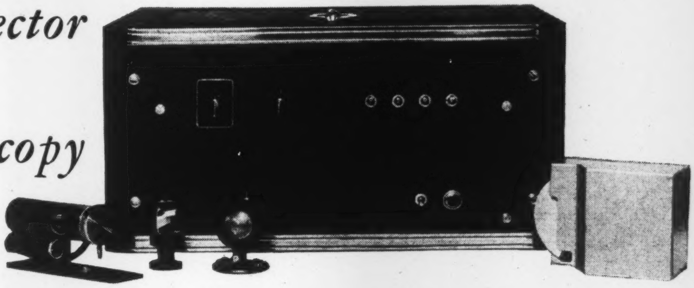
In plants where waste treatment has become necessary, the first step should be a thorough waste-water survey. This involves material balances around each manufacturing unit. Satisfactory balances can be obtained only by careful measurement of materials entering and leaving the process, and analysis of representative samples in the laboratory. The analytical study may require one or more of the familiar laboratory instruments: pH meter, turbidimeter, spectrophotometer, titrimeter, polarograph, refractometer, and so forth.

The water survey almost always discloses several places where unnecessary waste is occurring. The waste may range from extravagent use of water to serious losses of raw material and semi-finished products. These findings will often suggest installations of instruments to warn operators when excessive losses occur, to record operating conditions, or to provide automatic control. It is instructive to observe the rapidity with which devices that have long been considered only laboratory tools are being converted into control instruments. Among these are spectral analyses, refractive index, redox potential, amperometric titration, filterability, and the like.

Instrument control of processs to prevent waste may range from a simple warning device, such as a pH element for sounding an alarm when acid or alkali exceeds a limiting value, to full process control. Full control would normally be a desirable ideal, but this is not always attainable. In addition to the more commonplace control devices, a few special applications may be listed to suggest the potentialities of instruments for waste prevention. The polarograph is used to determine carry-over of aluminum chloride catalyst in petroleum processing, and to indicate residual oxides of nitrogen in high explosives. Conductivity cells measure leakage of sugar into condensate tubes; although sugar is a nonconductor, it contains a small percentage of organic salts which permits detection of as little at 40 ppm. of sugar.

*A Superior Detector*
*for*
*Infra-red Spectroscopy*

**GOLAY PNEUMATIC DETECTOR**



Among the characteristics that render the Golay Detector superior to other types of detectors for use in infra-red spectroscopy are:

1. An effective sensitive area 3/32″ in diameter.
2. Sensitivity of $6 \times 10^{-11}$ watts RMSENI when used with "chopped beam" method and with recording time constant of 1.6 second.
3. Uniform sensitivity from the ultra-violet through the visible and the entire infra-red, and up to the micro-wave region.
4. Improved, drift-free, A.C. operated amplifier with step gain controls and four response periods.

*Write for EPLAB Bulletin No. 10*

**THE EPPLEY LABORATORY, INC.**
**SCIENTIFIC INSTRUMENTS**
**NEWPORT RHODE ISLAND U.S.A.**

**INSTRUMENT — MERCURY USERS —**

**demand**

- ★ **PUREST Quality**
- ★ **BEST in Packaging**
- ★ **REASONABLE Price**
- ★ **PROMPT Delivery**

**Instrument Mercury**
**is**

**PURE** to better than one part per million (Certificate of Analysis with every order)
**PACKAGED** in handy "Squeeze" bottle with Dispensing Tip
**SOLD** at Lowest Prices Consistent with High Quality
**SHIPPED** from stock in 1, 6 and 16-lb. bottles

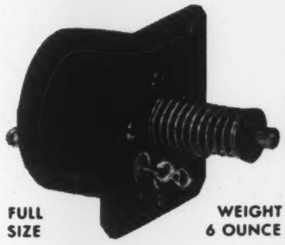
**Write for Bulletin I. M. and current prices**

**BETHLEHEM APPARATUS CO., INC.**
**887 Front St. Hellertown, Pa.**

**DISPLACEMENT TRANSDUCERS**

Input: linear motion .1″ to .4″
Output: voltage-ratio

**SERIES 222**



**FULL SIZE**
**WEIGHT 6 OUNCE**

**PRECISE - COMPACT - RUGGED**

**Write for complete technical information**

**COLVIN LABORATORIES**
MORRISTOWN NEW JERSEY

**Other Displacement Transducers with strokes .5″ to 5.75″**
**Pressure Transducers 0-1 to 0-6000 psi Pressure Switches**

LET'S LOOK INTO THIS NEW ALCOA ALUMINUM COILED TUBE!

If you're looking for the lowest cost, corrosion-resistant tube you can buy, it's called Alcoa UTILITUBE*. (Up to 40% less than other corrosion-resistant metals.)

If you want a tube that stands up well under vibration and also forms and flares easily, that's Alcoa UTILITUBE.

If you have many jobs for coiled tube, see what Alcoa UTILITUBE can do: fuel oil and gasoline lines—instrumentation lines—brake and hydraulic lines—refrigerants (except methyl chloride)—oil and grease lines.

UTILITUBE and fittings are available from your aluminum distributor. Look for his name in your classified telephone directory. Write for a copy of the new booklet, *ALCOA UTILITUBE.*

**ALUMINUM COMPANY OF AMERICA**
**838-M Gulf Bldg. • Pittsburgh 19, Pennsylvania**

* ®

ALCOA ALUMINUM ®

ALCOA
UTILITUBE
(850S)
ALUMINUM COMPANY OF AMERICA

These cells are used also to control concentrations in the manufacture of concentrated sulfuric acid and oleum; neutralization of caustic carried over in mercerized cotton; acid concentration in wool carbonization; caustic losses in washing sulfate pulp. pH control is used widely in unit operations such as precipitation, coagulation, neutralization, electrodeposition, electrodecomposition, and fermentation. In general, adoption of instrument control of processes provides a high degree of product purity and uniformity; avoids re-running or wasting of off-quality material; and prevents wasteful use of raw materials and utilities.

*Control of Waste Treatment*

Instrument control of waste treatment is usually much more difficult than control of manufacturing processes because of the complexity and variability of the water requiring treatment. Where the treatment involves only neutralization of a liquid of relatively uniform composition, full instrument control is sometimes possible. Where waste waters vary unpredictably in composition and volume from day to day, instrumentation is difficult or impossible.

Where regulatory agencies have established maximum limits for certain components of an effluent from a treatment plant, instruments sometimes can be employed to indicate or record a number of effluent variables. For example, instruments might be used to record flow rate, pH, temperature, turbidity, color, or chlorine residual. For records other than these, instruments are not ordinarily useful. This arises largely from the non-specificity of instruments for definite factors; the low level of concentration usually demanded; and the lack of instruments suitable for measuring variables such as biochemical oxygen demand, oxygen consumed, or toxicity.

### Recording Stream Quality

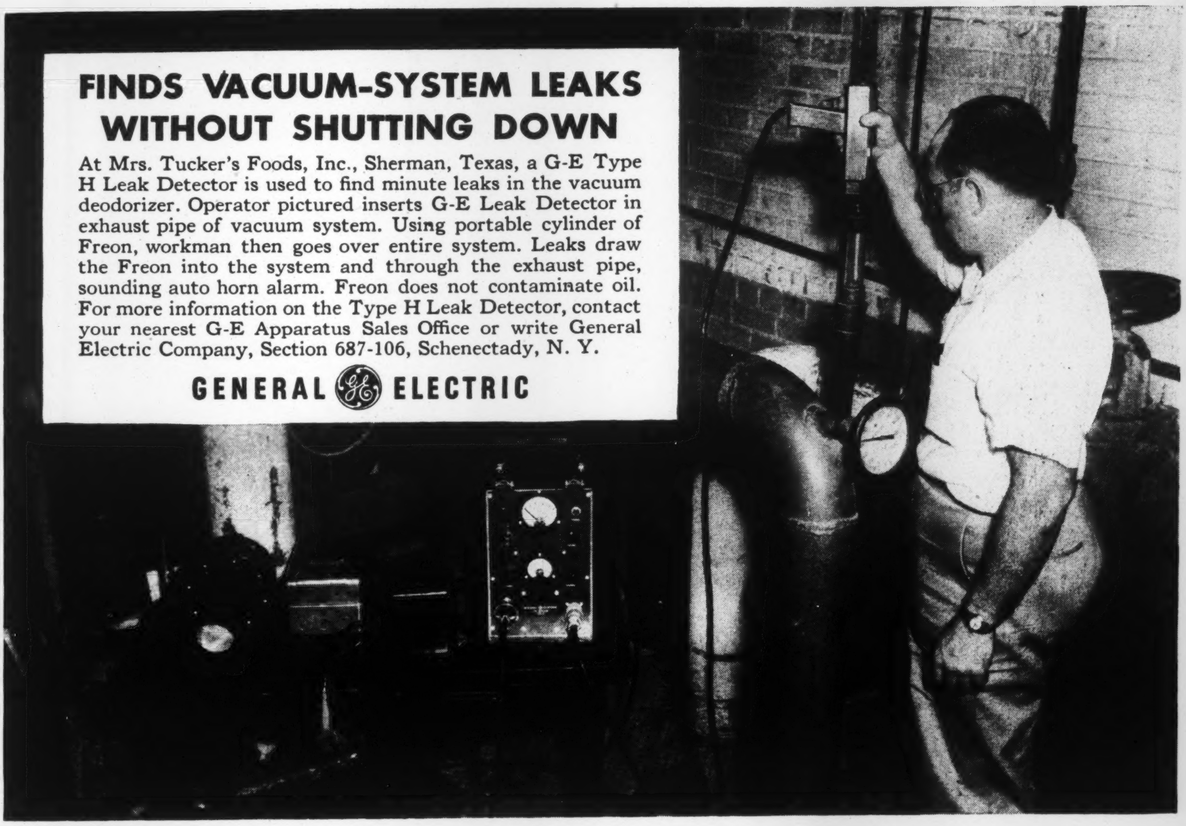
There is a growing conviction among workers in the field of stream-pollution abatement that streams themselves must provide the final criteria of what may be discharged to them. This attitude reflects an acknowledgment of the economic importance of streams as an agency for carrying away the liquid residues of civilization. At the same time, it recognizes the rights of downstream owners; the capacity of streams for self-purification; and the esthetic and recreational values of undefiled bodies of natural water.

Our knowledge of the specific effects on stream ecology of most pollutants is scanty. For this reason it seems illogical and uneconomical to set arbitrary limits for various plant effluents if knowledge of their effects is lacking. Final decisions should relate the concentration of a given waste component after thorough dispersion in the receiving water. Many of those who insist on a universally high degree of waste treatment seem unaware that the cost of the facilities must finally be borne by the public. Emphasis is too often placed on waste treatment instead of stream improvement.

Use of stream condition as a measure of the kind and amount of waste it may be expected to assimilate, can be approached from either the biological or the physicochemical point of view. Both of these methods are frowned upon by many public health engineers because it is claimed that they would be impossibly difficult to administer. Admittedly, troublesome problems might arise where several neighboring industries contribute different wastes to a stream, but these questions would not necessarily be insoluble. A measure of good will on all sides is amazingly effective in resolving disputed points.

The biological assay method is gaining increasing acceptance as a result of a survey made on recommendation of the Pollution Abatement Committee of the Pennsylvania State Chamber of Commerce and sponsored by the Pennsylvania Sanitary Water Board. The physicochemical method, which has not yet been tried on a large scale, should be of particular interest to specialists in instrumentation.

Although a variety of physical and chemical factors operate in streams and affect aquatic life in many ways, certain of these factors are relatively fundamental and might be combined to provide a kind of index of stream quality. Three factors affect stream biota directly: temperature, pH, and dissolved oxygen. The effects of two others, turbidity and color, are usually indirect through their influence on



## FINDS VACUUM-SYSTEM LEAKS WITHOUT SHUTTING DOWN

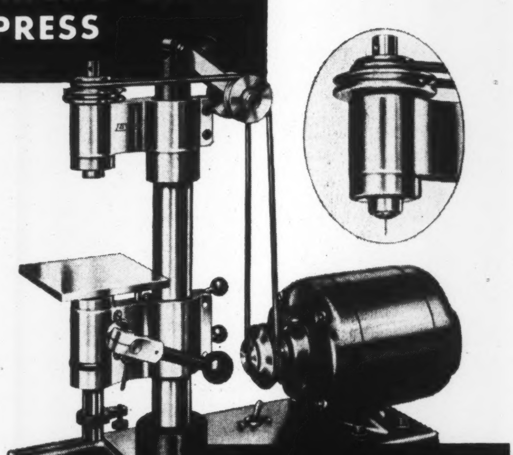
At Mrs. Tucker's Foods, Inc., Sherman, Texas, a G-E Type H Leak Detector is used to find minute leaks in the vacuum deodorizer. Operator pictured inserts G-E Leak Detector in exhaust pipe of vacuum system. Using portable cylinder of Freon, workman then goes over entire system. Leaks draw the Freon into the system and through the exhaust pipe, sounding auto horn alarm. Freon does not contaminate oil. For more information on the Type H Leak Detector, contact your nearest G-E Apparatus Sales Office or write General Electric Company, Section 687-106, Schenectady, N. Y.

**GENERAL ELECTRIC**

## LEVIN®

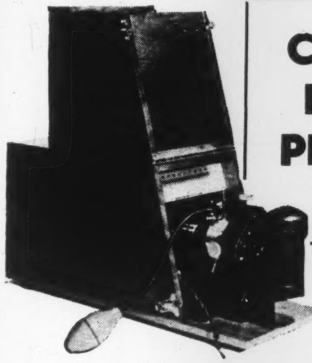
## MICRO-DRILL PRESS

for holes as small as .002"



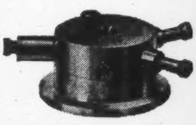
Designed to hold small drills in precision collets. Absence of a sliding quill guarantees extreme sensitivity with finger-tip control. A mounted 1/8" capacity drill chuck can also be used.

Write for Bulletin H describing the Micro-Drill Press and listing collet sizes. Louis Levin & Son, Inc., 782 E. Pico Blvd., Los Angeles 21, California.



## CAMBRIDGE PORTABLE PROJECTION VIEWER

This new Projection-Viewer, used in conjunction with the Lindemann-Ryerson Electrometer, facilitates observation of the deflection of the electrometer pointer. A beam of light from a lamp in front of the case projects the image of the index pointer onto a mirror in the rear of the case. This image, magnified 100 times, is then reflected upon a translucent screen, clearly visible in the front and upper part of the case. This screen is 120 mm. long and is divided into 120 divisions numbered 60-0-60. The pointer is zeroed by grounding the electrometer by means of a rubber bulb.



3¼" x 2⅜" x 1⅜"
Weight 3½ oz.

### LINDEMANN-RYERSON ELECTROMETER

This instrument is extensively used for the determination of radioactive emission. Has high sensitivity, good stability and does not require leveling.

*Send for descriptive literature*

**CAMBRIDGE INSTRUMENT CO., INC.**

**3742 Grand Central Terminal, New York 17, N. Y.**
**Pioneer Manufacturers of Pioneer Instruments**

DIALCO
for YOUR product
ACTUAL SIZE
Cat. #613529-211
ACTUAL SIZE
Cat #8-1930-621

WHICH PILOT LIGHT DO YOU NEED?

**THE BIG ONE**

This Pilot Light Assembly was first made to accommodate the *S-11 lamp* and was intended for use in the cabs of great diesel locomotives.

or

**THE LITTLE ONE**

The miniaturization program on defense products required the development of this *sub-miniature* light. It is used on communication equipment and aircraft. Midget flanged base bulbs to fit are rated 1.3, 6, 12, and 28 volts.

**Dialco HAS THE COMPLETE LINE of INDICATOR and PANEL LIGHTS**

Samples to suit your own special conditions and requirements will be sent promptly and **without cost**. Just outline your needs Let our engineering department assist in selecting the **right lamp** and the **best pilot light** for YOU.

**Write for the Dialco HANDBOOK of PILOT LIGHTS**

*Foremost Manufacturer of Pilot Lights*

**The DIAL LIGHT COMPANY of AMERICA**

60 STEWART AVENUE, BROOKLYN 37, N. Y. HYACINTH 7-7600

photosynthesis. If the variation of these five vectors, plus stream stage and effluent flow rate, could be continuously recorded, there would be available a history of stream condition that would be invaluable in deciding responsibility for objectionable conditions. The relative importance of the items suggested might not be agreed upon unanimously, and means for combining them into an index of stream quality might be difficult, but the proposal is worth careful consideration. Substances that cause serious effects in minute concentration, such as direct-acting toxins and taste-producing compounds, could not be evaluated in this manner, but these always pose special problems.

Instruments for continuously recording temperature, pH, stream stage, and flow rate are standard. Instruments for dissolved oxygen are available; they operate by comparing the conductivity of heated, platinum filaments in pure hydrogen and in hydrogen that has been used to strip dissolved oxygen from water. Turbidity and color present a more difficult problem. Although there are instruments for measuring both, turbidity is a function of the size, shape, and number of suspended particles; color measurement depends on transmitted light. Variation of these physical properties of stream water might cause calibration difficulties. If a change in order of magnitude of these factors would provide an adequate record, it is possible that existing instruments could be used.

A somewhat different method of instrument control of waste water has been proposed. It is similar to the one outlined, but has a slightly different purpose. A group of instruments would record certain characteristics of an effluent stream, and whenever an established limit was exceeded an alarm would be sounded and a sample collected automatically. This would serve to notify plant personnel when the treatment plant was not operating satisfactorily and would provide samples for laboratory analysis.

These pollution-control instruments would serve an important purpose by providing an indisputable record of stream condition. Both methods probably require considerable study before practical devices could be developed. The function of waste treatment is not only to overcome local pollution problems but to effect a gradual improvement in the quality of surface waters. Means for obtaining a continuous record of stream conditions would help immeasurably in achieving this objective.

## ULTRASONICS

*Continued from page 1721*

normal to the searching unit, which is the only energy that is likely to be reflected back to the searching unit.

On a forged, rolled, or ground surface, there is intimate contact between searching unit and material, and all the sound energy is transmitted normal to the work surface. Such a surface is excellent for ultrasonic inspection.

Good contact is obtained on a light machined surface, but there is scattering of the sound from the normal because of refraction at the tool marks. Refraction sometimes may cause a surface wave to be generated, which can lead to a false interpretation of the sound pattern.

On a heavy machined surface, a more pronounced scattering of the sound beam occurs, but there is sufficient energy transmitted normal to the work face to make a reliable and sensitive test.

A convex surface is satisfactory for testing. At the line of contact the sound is introduced normal to the surface, but on either side of this line of contact the sound is refracted slightly by the oil couplant. This gives a wide-angle sound cone, which is generally advantageous in testing rounds and other convex surfaces.

A concave surface is poor for testing, although not entirely impossible. Using a heavy oil or grease to fill the concavity, about 11 percent of the sound energy can be transmitted into the steel. Of this amount, however, only a fraction enters the steel normal to the searching unit, and the balance is refracted by the oil at diverging angles.

A rough surface, such as a casting, is generally a fair test surface provided it is not covered with sand; the nonuniformity of such a surface makes it impossible to predict the amount of energy transmitted normal to the searching unit, and only gross defects can be detected reliably.

The sensitivity of the amplifier in the "Reflectoscope" makes it possible to test when only a fraction of one percent of the total energy is reflected back to the searching unit. On many surfaces, however, the amount of amplification is limited by pulse and surface noise.

### TEST REFERENCES

For practical use and acceptance of any nondestructive testing method, standards must be established. Most plants using ultrasonic testing have developed internal plant standards for their own use and reference. A committee of A.S.T.M. recently has started work on developing and establishing industry standards. Reference blocks with flat-bottom holes of various diameters from 1/64 to 1/4 inch are being considered. In using such reference blocks, two methods of interpretation can be made. The most common method is to tune the "Reflectoscope" so that the indication from the test hole gives a specified height. In testing, indications are evaluated at less than or greater than the reference indication height.

The other method of interpreting is to compare the height of the indication to the height of the back-reflection, and to express this as a percentage of the back-reflection. This method has the distinct advantage that size, shape, and surface conditions do not vary the relationship.

In the standardization program, test frequencies also are being suggested and adopted. For example, in the tool-steel, aircraft, and forging industries, a test frequency of 2½ megacycles per second is the accepted and used frequency. In the foundry industry, frequencies of 1 and ½ megacycles per second are considered standard.

### TEST OF A FORGED ROTOR

Fig. 6 shows a test of a large forging or casting. When the searching unit is placed in position "A" the sound pattern shown below is obtained. The sound travels through the piece and reflects off the shoulders as well as the end. The small regular signals are markers which can be set to represent any desired distance. With each marker set for 6 inches, the operator can measure distances to all shoulders and the end, and thus confirm that the sound has penetrated the roll to the end without any abnormal indications. In such an "end-test" the operator generally looks for transverse cracks.

Tests along the O.D. surface, as in position "B," are made for examining the center area for longitudinal cracks, voids, and pipe. If the forging contains center porosity, the sound pattern shows the extent and area of such porosity, as in B of Fig. 6.

### MAINTENANCE TESTING

A typical maintenance application is to test installed shafting, press columns, crankshafts, and other highly stressed parts subject to fatigue action. Such applications require both experience and judgment, or enough similar pieces that comparison tests can be made.

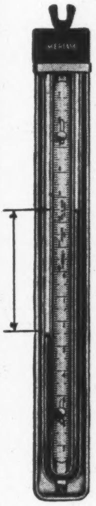
In testing a crane shaft (Fig. 7) the direct sound path is to the opposite end. Some of the sound reflects back from the fillet, and gives a small indication at the correct fillet distance. However, the sound that strikes the fillet at 29 degrees is converted into shear, crosses the shaft at 90 degrees, is converted back into longitudinal sound, and returns to the searching unit. This sound path is shown in "A" of Fig. 7. A false indication appears at a distance the diameter of the shaft in back of the fillet. In the testing of any pieces with fillets or tapers, the possibility of a false shear reflection must always be investigated before condemning the piece. A quick method for confirming or disproving such an indication is to test from the opposite end. Distance measurements always confirm a crack at a specific location, but distance measurements from both ends will never jibe with false shear indications.

### END REFLECTIONS

Another interesting phenomenon occurs in end tests of pieces whose length is large compared to thickness. Instead

MERIAM
INSTRUMENTS
FOR INDUSTRY

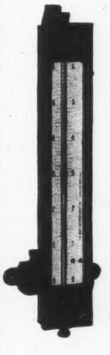
For 37 years we have been solving measurement problems by supplying standard or special instruments to accurately measure pressures, vacuums and flows of liquids and gases. We have constantly improved, developed and diversified the line so as to meet fully all needs of the field.



**U-TYPE MANOMETERS**

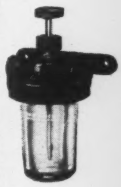
**The Clean-Out Manometer** (at left) for line pressures up to 100 lbs. per sq. in. A wing nut permits the Manometer body and tube to be disconnected from the head — the tube cleaned with a brush furnished or tube replaced, and the instrument reassembled without disconnecting the head section from the piping. Send for Bulletin No. 1.

**The Model A-995 WM Manometer** for line pressures up to 400 lbs. per sq. in. These instruments are built with heavy walled annealed straight Pyrex tubes, gland packed top and bottom in steel end blocks and clamped to the body at fixed intervals to prevent distortion. Catalog Sheet A-995 WM gives complete details.



**WELL-TYPE MANOMETER**

Model A-275 WM (at left) is a direct reading type for line pressures up to 150 lbs. per sq. in. Standard construction; ranges — from 6" to 24". Wall mounted type shown; also available in flush mounting. Ask for Catalog Sheet A-275 WM.



**SIGHT FEED BUBBLER**

This Sight Feed Bubbler with 2½" dia. bowl of Pyrex glass is good for line pressures up to 50 lbs. per sq. in.; of plastic, for pressures up to 100 lbs. Sturdily built with brass or semi-steel body. Supplied in ring type (shown) and strap type. Needle valve controls bubbler rate. Ask for Bulletin 21.

**THE MERIAM INSTRUMENT CO.**
10958 MADISON AVENUE • CLEVELAND 2, OHIO
WESTERN DIVISION: 4760 E. OLYMPIC BLVD., LOS ANGELES 22, CAL.
IN CANADA: PEACOCK BROS., LTD., MONTREAL

MERIAM
Instruments
ESTABLISHED 1911
MANOMETERS, METERS AND GAUGES FOR THE ACCURATE MEASUREMENT OF PRESSURES, VACUUMS AND FLOWS OF LIQUIDS AND GASES

FOR NEW BUSINESS FROM OVERSEAS–

wise manufacturers and exporters everywhere use an international journal—for none other has the pulling power of a publication which penetrates into all world markets.

MACHINERY LLOYD is such a journal. Two editions are published every fortnight—the OVERSEAS EDITION which is mailed to the British Dominions and Colonies, North, Central and South America and the Middle and Far East; and the EUROPEAN EDITION, which is read by buyers in Great Britain, every country throughout the Continent of Europe, and the French and Belgian overseas possessions. The fortnightly circulation of each edition is 12,000 copies, and the two cover more than 120,000 different addresses in classified rotation.

MACHINERY LLOYD

To readers of this advertisement whose interests lie in import rather than export, we extend a cordial invitation to subscribe to the OVERSEAS EDITION. Every issue is packed with up-to-date technical information on new machines and processes and contains a digest of industrial news from our own correspondents in Overseas markets. The subscription fee is $7.00 for 26 issues a year.

Introductions to British suppliers of all types of engineering equipment. Answers to technical problems. Disposal or acquisition of rights to manufacture and sell under license. Assistance in securing agencies from reputable British manufacturers.

SERVICES FREE

PUBLISHED IN ENGLAND
BUT
READ EVERYWHERE

Member of the AUDIT BUREAU of CIRCULATIONS

Ask for advertisement rate cards and free specimen copies—

MACHINERY LLOYD
6 Cavendish Place, Regent Street,
LONDON, W.1—ENGLAND

of a single back-reflection, two or more equally spaced reflections are likely to appear. The sound causing these extra reflections is sound that crosses the thickness at a constant angle and a constant velocity. Thus the spacing of these end reflections is a measure of the thickness of the piece. In steel, the thickness of the piece is equal to the spacing between any two reflections divided by 0.76. In aluminum the constant is 0.90.

The stray sound paths must occur after the direct reflection because such paths are longer and, in wave transformations, velocities are much slower. It is a good general rule, therefore, to consider only the distance to the first end-reflection in interpretation, and to ignore the miscellaneous reflections that follow.

### THICKNESS MEASUREMENTS

Two methods of measuring thickness with ultrasonics are commercially available; each has certain advantages and limitations. The method based on resonance is particularly applicable in thickness ranges of 0.025 to 0.300 inch, and where surfaces are not corroded or immersed.

*Reflection technique* for measuring thickness is illustrated in Fig. 8. A 5-megacycle searching unit is best because it produces a short pulse and better definition. Using a reference piece 1-inch thick, and of the same material to be measured, the "Reflectoscope" is calibrated by marking the spacing of successive reflections on the oscilloscope tube, or by accurately setting the markers for ½-inch increments. The scope pattern is shown in "A" of Fig. 8.

If the thickness of the reference piece is reduced by 1/32 inch, the first reflection shifts 1/32 inch to the left; the second reflection shifts 2/32 inch, and so on. Thus the 8th reflection occurs at 7 3/4 inches instead of at 8 inches. The slight shift at the first reflection might not be discerned or measured, but the 1/4-inch shift at the 8th reflection can be read and measured easily. The rule for taking accurate thickness measurements is to read the length of multiple thicknesses, and divide by the number of multiples.

In measuring a 1/4-inch pipe wall, it is difficult to count the number of multiples because some are obscured in the pulse. Therefore count the number of multiples in one inch, which gives a direct thickness reading.

Thickness measurements with the "Reflectoscope" are not extremely accurate, but its ability to measure metals which have corroded inside surfaces and which are backed by liquids often makes it the only possible way to obtain thickness measurements.

### ANGLE TESTING

Another general application of ultrasonic testing is the use of shear waves introduced from the surface of the material at an approximate angle of 45 degrees (Fig. 9). A quartz crystal mounted on a lucite wedge of about 36 degrees is assembled in a suitable holder. Refraction causes the sound to enter the steel at approximately 45 degrees; at this angle 90 percent of the incident energy is converted into shear waves. Due to the slow velocity of shear waves, their wavelength is proportionately shorter; testing at 1 megacycle with an angle search-unit is approximately equivalent in sensitivity to testing with a 2 1/4-megacycle standard search-unit. Fig. 9 shows the technique and typical patterns.

Angle testing is coming into general use also in the testing of pipe and tubing. Fig. 10 shows the sound paths and sound patterns. Note that there is no longer a sound beam, but a wide variety of angles and modes of vibration.

Another method of testing, presently being developed by the aircraft industries, is to immerse the material in water and eliminate direct surface contact of the searching unit. Although 88 percent of the sound energy is reflected back at the water-steel interface, and only 1 percent returns to the searching unit, the test has been proven to be practical despite the 99 percent energy losses.

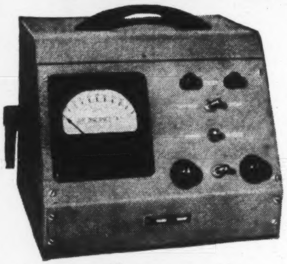
### SEMI-AUTOMATIC TESTING

In ultrasonic testing, the value and usefulness of the results depend entirely upon the instrument operator, and proper supervision. Automatic handling equipment for repetitive testing is available.

IT'S PORTABLE, VERSATILE, ACCURATE!

THE NEW GOW-MAC GAS-MASTER

—featuring simple operation and 30-second response



**FOR LABORATORY OR PLANT**—Get accurate, reproducible readings anywhere with the lightweight, compact, portable GAS-MASTER.

**SIMPLE TO USE**—Enables the technician to read changes in gaseous mixtures in minutes, saves hours of laboratory work by the chemist. Recorder chart gives perfect summary of test data.

**LESS THAN 30 SECONDS** required for full deflection from most gas quality changes, at sample flow rate of only 100 ccpm.

*—versatile operation*

Any simple gas or mixture can be used for reference. Monitors adsorption, drier and reaction towers by "comparative analysis." Multi-applications widened by double gas passages, optional use of indicating meter or your recorder, and calibrating resistor in galvanometer circuit for optimum use of full-scale range.

FOR COMPLETE DATA request literature and state your specific gas analysis problem.

GOW-MAC INSTRUMENT CO.
22 LAWRENCE ST., NEWARK 5, NEW JERSEY

INSTANT, ACCURATE READINGS AND SETTINGS...

*Distinctive Appearance for your instruments!*

The new turns—indicating MODEL RA Precision Duodial

NOW you can give your instrument panels distinctive appearance — as well as greater convenience and accuracy — with the new easy-to-read RA Precision DUODIAL . . .

- *Designed for accurate readings on multi-turn rotational devices (such as helical potentiometers, coils, threaded positioning devices, etc.) the RA provides two scales . . . an inner to show rotational position in a full 360° circle, and an outer to show number of turns (up to 15) completed from "zero" point.*
- *Unique jump mechanism allows outer dial to remain stationary until inner dial has completed full revolution—then dial "jumps" to next numeral. Assures quicker readings—greater accuracy. Together, dials give a direct decimal reading—without interpolation—for 10-turn components such as Model A Helipots.*
- *Vibration-proof lock is instantly set to hold reading—as quickly released for new setting.*
- *Completely pre-assembled, installation is quick and simple. Fits both thick and thin (1/8" and less) panels.*

The precision "feel" and handsome appearance of the RA DUODIAL—recessed black numerals on satin chrome dial with non-metallic parts of black nylon—add quality and distinction to the finest instrument panels.

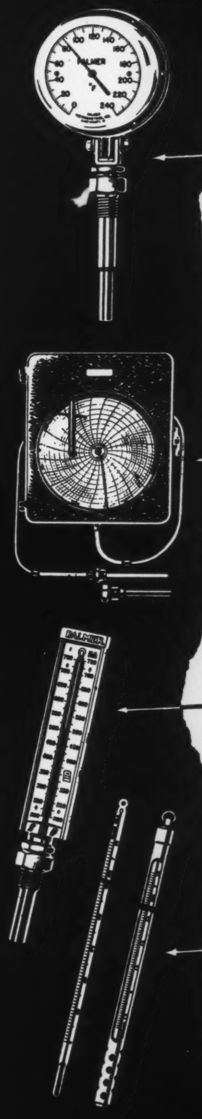
See one . . . try one . . . get complete details on the Model RA Precision DUODIAL from your nearest HELIPOT representative. Or write direct!

THE Helipot CORPORATION
*A subsidiary of Beckman Instruments, Inc.*
SOUTH PASADENA 11, CALIF.

SINCE 1872 Leading American Industries have depended upon . . .

PALMER

MERCURY ACTUATED
Temperature Indicating Instruments



**4½" DIAL THERMOMETERS**

Made in 3 types to suit any requirements. Rigid stem, wall or flush mounted, 11 inches of scale reading. Interchangeable with standard industrial separable sockets. Stem can be placed at any angle and case can be rotated to any readable position.

**RECORDING THERMOMETERS**

Twelve inch die-case aluminum case with black or white wrinkle or satin finish. Single or multiple pen construction. Electric or spring wound clock, 24 hour or 7 Day Revolution. Flexible Armor and bulb of stainless steel. Ranges —40 +950°F or Equivalent in °C.

**INDUSTRIAL THERMOMETERS**

Red-Reading Mercury—Extruded brass case—chrome finish. Ranges —40 +950°F or Equivalent in °C.

**RED-READING MERCURY LABORATORY THERMOMETERS**

Thoroughly annealed for permanent accuracy. Complete line A.S.T.M. and fractional division types.

**FOR COMPLETE INFORMATION WRITE FOR CATALOG 200 G**

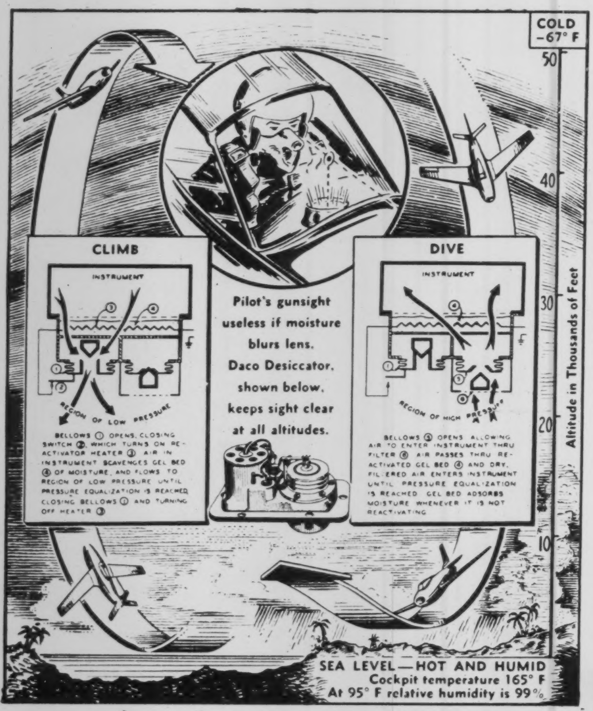
PALMER THERMOMETERS, INC.
CINCINNATI 12 OHIO
Telephone MElrose [illegible]

# INSTRUMENTS ON THE MARCH

## New Principles, Applications, Non-commercial Developments

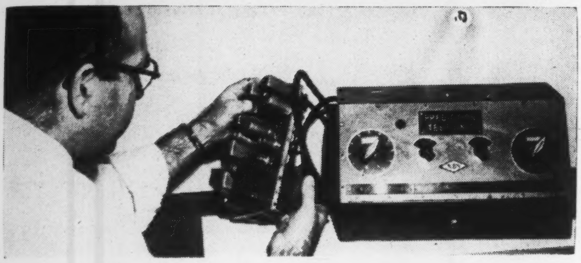
## Miniature Air Conditioner

INDIANAPOLIS, Ind.—The Naval Ordnance Plant at Indianapolis has completed a successful test of a miniature air-conditioning system, developed particularly to eliminate fogging, freezing and dirt-infiltration of aircraft gunsights, but having widespread instrument applications. When used with optical, electronic and mechanical instruments, it solves the problems involving humidity that result when a plane changes altitude. Developmental work is under way on new models for application on time clocks, instrument storage cabinets, etc. The present model has a size of 4.5 x 2.5 x 2.5 in. and weighs only 13 ounces. It is made by Daco Machine & Tool Co., Brooklyn, N. Y.


COLD -67° F
50
40
30
20
10
Altitude in Thousands of Feet
CLIMB
INSTRUMENT
③
④
①
②
REGION OF LOW PRESSURE
BELLOWS ① OPENS, CLOSING SWITCH ②, WHICH TURNS ON REACTIVATOR HEATER ③ AIR IN INSTRUMENT SCAVENGES GEL BED ④ OF MOISTURE, AND FLOWS TO REGION OF LOW PRESSURE UNTIL PRESSURE EQUALIZATION IS REACHED CLOSING BELLOWS ① AND TURNING OFF HEATER ③
Pilot's gunsight useless if moisture blurs lens. Daco Desiccator, shown below, keeps sight clear at all altitudes.
DIVE
INSTRUMENT
④
①
⑤
⑥
REGION OF HIGH PRESSURE
BELLOWS ⑤ OPENS ALLOWING AIR TO ENTER INSTRUMENT THRU FILTER ⑥ AIR PASSES THRU REACTIVATED GEL BED ④ AND DRY, FILTERED AIR ENTERS INSTRUMENT UNTIL PRESSURE EQUALIZATION IS REACHED GEL BED ADSORBS MOISTURE WHENEVER IT IS NOT REACTIVATING
SEA LEVEL—HOT AND HUMID
Cockpit temperature 165° F
At 95° F relative humidity is 99%

## Prediction of Electronic Failures

WASHINGTON, D. C.—A relatively unexplored approach to the problem of insuring higher reliability of electronic equipment is being investigated at the National Bureau of Standards. The Bureau is studying the feasibility of detecting incipient failures of equipment long before they perceptibly affect over-all performance. A technique has been evolved experimentally in which a maintenance man simply plugs a portable failure-prediction unit into the slightly-modified equipment to be checked and turns a multi-point selector switch; a red light flashes on to identify stages or components that have deteriorated below safe levels. Successful failure prediction requires that the condition of each important stage or small group of stages be established individually. The figure shows a failure-prediction test being made on a military radio receiver. The connector from the experimental prediction test unit (right) is simply plugged into the connector that has been adedd to the slightly-modified receiver. It then takes only a few seconds to make an incipient-failure check by rotating one of the selector switches (large knobs). The test method relies principally on detecting decrease of tube transconductance, but provision is also made (small switches) for measuring voltages and currents, and for sensing capacitor leakages. This type of failure-prediction technique offers the possibility of improving dependability of electronic equipment by means of quick-and-easy routine checks by unskilled personnel.



## Tension Measurements

CAMBRIDGE, Mass.—The New England Transformer Company, 47 McGrath Highway, Cambridge, Mass., uses a Tension Meter of Saxl Instrument Co., Harvard, Mass. to speed up operations and reduce breaks. They have been getting more uniform coils even when made with the finest, most sensitive wires. The tension with which a

SAXL TENSION METER
SAXL INSTRUMENT CO.
HARVARD MASS. USA

# 2 NOW AVAILABLE!

**for the first time, the only miniature electronic recorder and miniature electronic controller**

# 2 NEW SWARTWOUT *Autronic* PACKAGES

## for accurate, instantaneous temperature control and recording

NO MATTER what the process . . . no matter how stringent the control requirements — if it can be done with a pneumatic or electro-mechanical system, it can be done better, faster, easier and generally at less cost with one of the two new *Autronic* Packages.

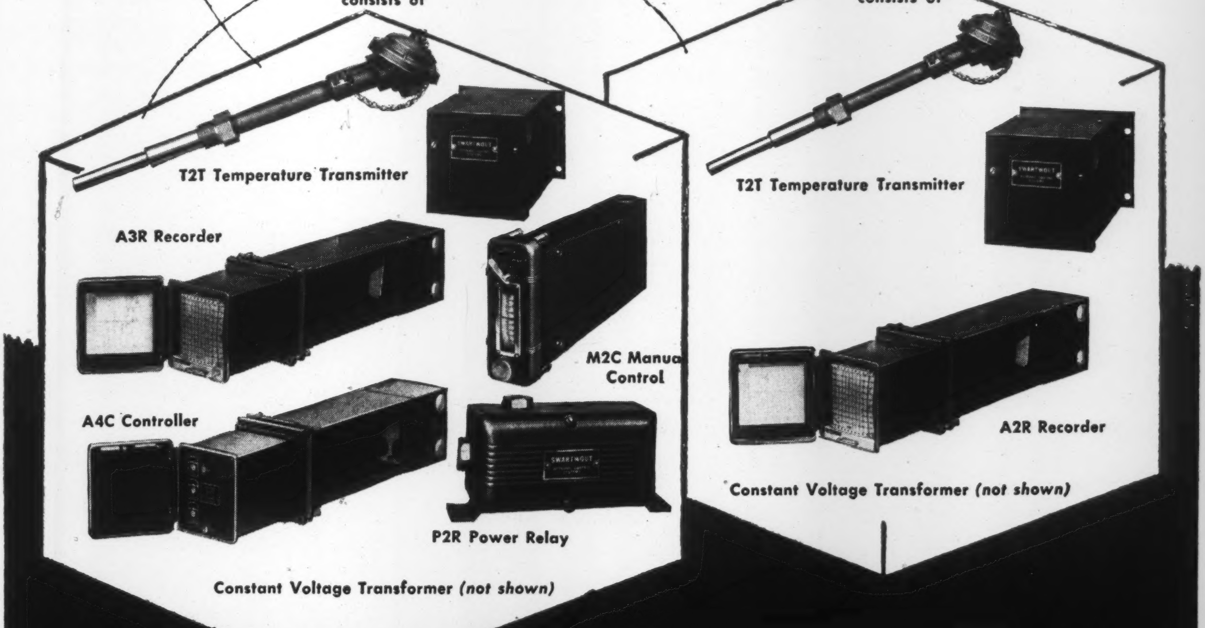
Since the *Autronic* System is *all-electronic,* it eliminates transmission lags . . . places no restriction on location of components. Other plus features are flexibility for multiple control systems . . . interchangeability of components without recalibration . . . elimination of expensive-to-install, troublesome air lines.

So if temperature control and/or recording is your problem solve it the *all-electronic* way — with a Swartwout *Autronic* Package. Literature and prices on request.

A-6556

**TEMPERATURE CONTROLLING AND RECORDING PACKAGE**
consists of

**TEMPERATURE RECORDING PACKAGE**
consists of


T2T Temperature Transmitter
A3R Recorder
M2C Manual Control
A4C Controller
P2R Power Relay
SWARTWOUT
T2T Temperature Transmitter
A2R Recorder

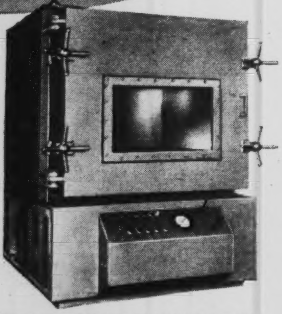
Constant Voltage Transformer *(not shown)*

Constant Voltage Transformer *(not shown)*

Swartwout

THE SWARTWOUT COMPANY • 18511 EUCLID AVENUE • CLEVELAND 12 • OHIO

New ALTITUDE SIMULATION CHAMBER



- Altitude Range to 120,000 feet.
- Temperature Range from 300°F. to —140°F.
- Micrometer Temperature Adjustments hold ±2°F.
- Compact Design . . . Requires less Floor Space
- Humidity Cycle available

Providing extreme flexibility in temperature and vacuum ranges, M & M Altitude Simulation Chambers give you precise control and easier, simpler operation that will reduce test costs considerably. Custom-quality built in every detail, M & M Chambers are designed to meet Government altitude simulation test standards. Available with many optional features to speed testing, such as Program Heating, Cooling, and Humidity Cycles, Automatic Recorder for controlling and integrating temperature, humidity and altitude. Write for details on Altitude SIMULATION Chambers as well as M & M Temperature Test equipment.

MURPHY & MILLER, Inc.
1112 South Michigan Avenue • Chicago 5, Illinois

If you design timing mechanisms, automatic devices, instruments, here's information you should have!

8-page catalog of Telechron® Synchronous Timing Motors

Here's complete, technical data on all standard models of Telechron Synchronous Timing Motors . . . with many typical applications listed. Get your free copy. Write Telechron Department, General Electric Company, 612 Homer Ave., Ashland, Mass.

wire is pulled while being drawn, wound into coils, or coated with lacquer influences the quality of the wire product and the speed of its manufacture. The Tension Meter indicates the tensions directly while the machines run.

## Analysis by X-ray Spectrometer

CHICAGO, Ill.—Irene Corvin, associate physicist at Armour Research Foundation of Illinois Institute of Technology, Chicago, Illinois, adjusts a specimen for analysis in Geiger-counter X-ray Spectrometer of North American Philips Company, Inc. Installed in the Physics of Solids Section at the Armour Foundation, the spectrometer is currently being employed for problems concerning qualitative identication, chiefly for the determination of phases and reflections in titanium alloys and work on confidential industrial projects.

## STEEL PLANT PROBLEMS

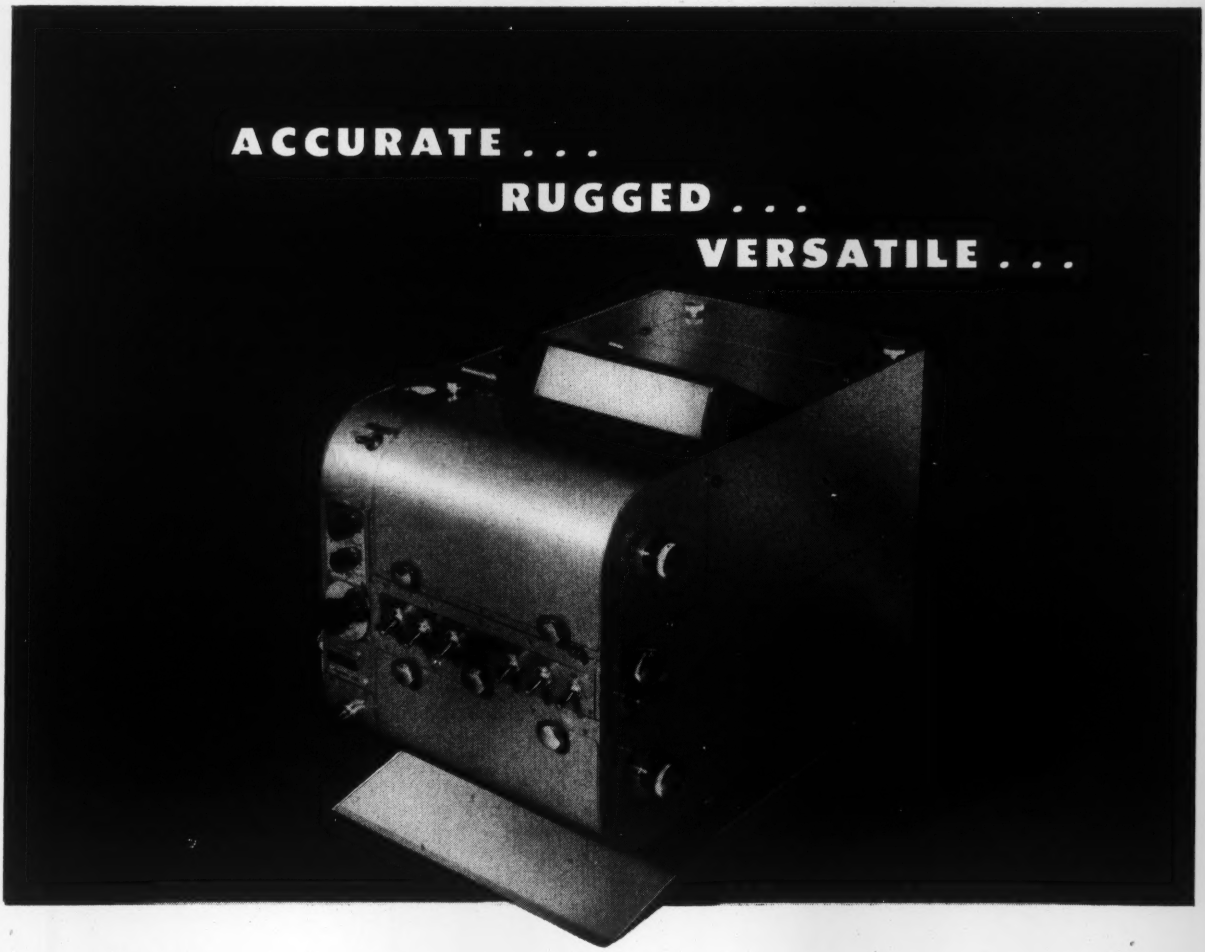
*Continued from page 1723*

performing the duties of the trade, (2) develop technical knowledge in subjects related to the trade, (3) impart an understanding of the problems of industrial management and the place of industry in the community, and (4) encourage continuing self-education and ambition toward advancement in the organization.

Instrument repairman training programs in industry are fairly new; only in recent years has the value of such training been realized. Industrial plants that have instituted this instruction have found that operating equipment is serviced and maintained more efficiently and at less cost than in plants that do not have training programs.

Some educational institutions have set up training courses in industrial instrumentation. The Instrument Society of America has a list of seven such institutions. It also has formulated a complete training program for the instrument man. Many instrument manufacturers have schools at their factories, which any instrument-minded person may attend for weeks or months to become familiar with that company's particular products. These facilities are offered without cost, other than living expenses.

How does one start training the beginner? This is a subject which will receive more and more attention. If a young man is to acquire a concept of how instruments function, he should be trained in several fundamental subjects—elementary physics, mathematics, electricity, and hydraulics. The grouping of related equipment eases the knowledge requirements of a beginner. Men who will specialize on any one kind of instrument can be given a more limited amount of information. However, all men must know how to (1) use hand tools, (2) repair pivots and bearings, (3) solder, (4) balance delicate parts and assem-



## *Midwestern Model 544 Oscillograph*

This fine instrument was designed with full knowledge of the recording problems encountered in laboratory, industrial and aircraft testing. It will record up to 36 separate channels of data. It is 11½ inches wide, 11½ inches high and 17 inches long. For use in this Oscillograph, Midwestern offers a wide variety of precision galvanometers with undamped natural frequencies up to 3500 cps. Write for complete oscillograph and galvanometer specifications.

FEATURING . . .

- Two separate daylight-loading magazines for exposed and unexposed recording paper.
- Trace identification (beam interrupter type)
- Precision tuning-fork-controlled electronic timer.
- Graduated external viewing screen.
- Continuously-variable paper speed.
- A wide selection of optional special components.

**MIDWESTERN GEOPHYSICAL LABORATORY**
3401 S. HARVARD TULSA, OKLAHOMA

ENGRAVING and MARKING

The Green Engraver

ENGRAVES, ROUTS PROFILES and MODELS

A real money saver for industry.
Proven by the experience of tool and die, electronic machine, radio, electrical and instrument manufacturers.

The Green Engraver zips out precision work on metal, plastics, wood, glass, hard rubber etc. . . . engraves panels, name plates, scales, dials, molds, lenses, instruments, instruction plates, directional signs . . . by simple tracing. *Routing, profiling and three dimensional modeling indicate its versatility.* Electric etching attachment available.

DIAL STENCIL

DIRECTIONAL SIGN

BARREL DIAL

*Specify the Green Engraver for the best in low cost performance.*

Special attachments and engineering service available for production work.

*FREE — Fact-packed folder yours upon request.*

Green Instrument Co.
INCORPORATED

383 Putnam Avenue
Cambridge 39, Mass.

Macbeth
instruments

Industrial pH Meter
Model I

For large scale industrial processes. Model I pH Meter may be employed with either immersion or flow type electrodes.

Design permits 2 sets of electrodes to be connected to the indicator. Simple switch control gives readings on either system.

Provision included for connection of sensitive relays for either automatic or manual pH control.

AC powered, direct reading, continuously indicating. Automatic temperature compensation.

MACBETH INSTRUMENTS
Laboratory Type pH Meter
Titration-pH Meter
Industrial pH Meter
Explosion-Proof pH Meter
Color Densitometer

MACBETH INSTRUMENT CORP.
a subsidiary of the
MACBETH CORPORATION
NEWBURGH, NEW YORK

blies, and (5) perform operations common to all types of instrument work.

The conditions under which instrument men are trained in the various industries must vary widely. In one instrument department the learner may be individually trained by means of on-the-job instruction. In another, teaching may be done in groups and in specially equipped training shops and by special instructors.

Of great importance are the qualifications of the *instructor*. He should have a solid background of instrumentation, both practical and theoretical.

Few people are aware of the extensive training that is necessary to produce a first-class instrument man. This man should be intimately familiar with the function and positioning of hundreds of parts in many makes of instruments and controllers. He also must know the processes to be controlled and possess the skill to keep a controller or instrument in harmony with the process.

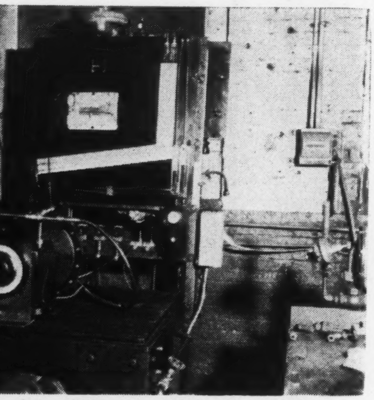


**Fig. 5. Unique test panel for calibration of Hydraulic controls.**

In selecting men to be placed in apprentice training it may be desirable first to look among that group of younger employees whose work experience includes association with processes involving instrumentation. Another choice is a graduate from some of the training institutes; these young men usually make excellent trainees.

An instrument department that is responsible for all types of instruments—pyrometry, electrical, flow, and combustion—should set up a schedule for the trainee. At the U. S. Steel Plant in South Chicago, our Instrument Repairman Apprentice schedule covers a four-year period. The training takes place in the shop and in the classroom with about 10 percent of the total hours devoted to related instruction in he classroom. During the four-year period, the apprentice covers the following four phases of instrumentation—pyrometry, electrical, flowmetering, and combustion control. While covering these four phases, the apprentice is systematically assigned to the major operating divisions of the plant.

In industries where a highly formalized apprentice program is not used, a *rigid schedule* may still be maintained in connection with the work of instrument repairman helpers. These helpers may be assigned to instrument technicians or journeymen, and a certain number of hours per week may be devoted to classroom work on company time covering mathematics, formulas, metering principles, hydraulics, and electrical theory.

Visual aids are highly desirable for instruction. They illustrate a point more adequately than theory lectures alone.

The instrument department supervisor has the problem of constantly training new men, or furthering the training of his present force; the continuous improvement and the redesign of instruments by manufacturers make it necessary for each man in this field to keep up-to-date with these developments. The supervisor also must keep pace with current trends as he is often called upon to make suggestions regarding the type of equipment required for certain applications.

## BUTTERFLY CONTROL VALVES

*Continued from page 1719*

degrees under its own action and remain there. It is, therefore, often desirable with such devices to provide a lock that will hold the valve in its last position, or to provide a reserve pressure source with sufficient capacity to stroke the valve to the desired position.

With the exception of a few specially designed valves, butterfly valves are not used as self-operated regulators because of their operating-torque characteristics, but are operated by a control instrument or pilot valve. The sensitivity of valve response required by the process is of importance in the selection of the operating equipment. The gap between the curves of "Torque to Open" and "Torque to Close" in Fig. 2 indicates that a hysteresis, or dead spot, occurs in the response of the valve when the operating device tries to reverse the valve movement. The operation of electric gear motor drives is not affected by the variation in oprating torque, and such units are sized to provide the maximum operating torque required. Springless-type diaphragm motors or cylinder drives utilize a valve positioner which determine the sensitivity to a large degree; however, it is accepted practice to size such operators so that maximum torque is two to three times the maximum operating torque required by the valve. This is done to insure adequate speed of operation with minimum cycling.

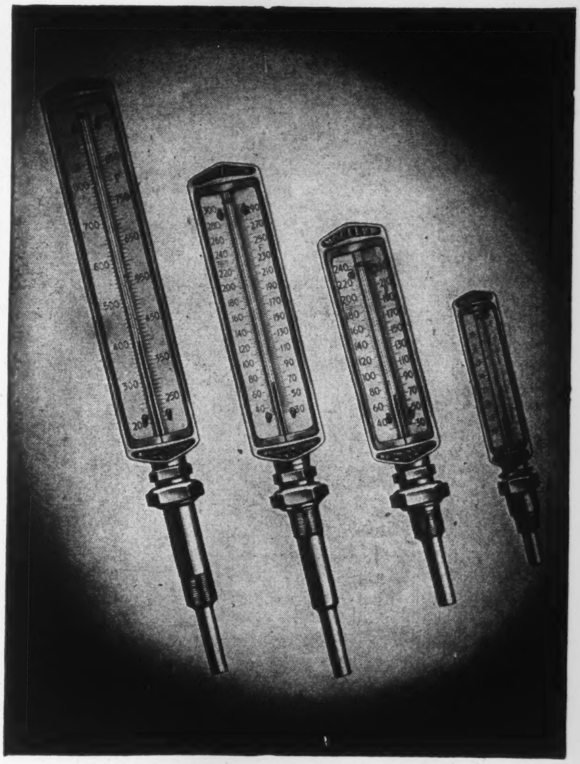
Selecting a spring-type diaphragm motor is more difficult. Theoretically it should be possible to use a diaphragm motor large enough that the relation between diaphragm pressure and valve travel would be almost the same as the spring characteristic of the motor. On many applications this is possible; however, two practical limitations may be encountered—the motor may be too large to mount on the valve or too expensive in comparison with other types of drives. Thus the required sensitivity of response dictates the motor size as well as the use of a valve positioner. As the use of a valve positioner does not make available any additional spring force from the motor, the selection of a spring-type motor must also reflect its spring limitations.

The fact should be noted that in the selection of motors for operating butterfly valves, both the area of the diaphragm (or piston) as well as the available travel of the motor are important. The torque produced on the valve shaft is determined by the stem force, which is a function of diaphragm area, and by the valve lever length, which is a function of the motor stem travel and the desired angular movement of the valve. Generally speaking, it is desirable to use an operating device with as long a stroke as possible that can be mounted on the valve. This reduces the overhung load on the valve shaft as well as the effect of lost motion in the linkage on the valve response.

### FLOW CHARACTERISTICS

On applicatons where a large variation in flow or pressure drop is anticipated, the process engineer must consider valve flow-characteristic and rangeability when sizing and selecting control valves. The flow characteristic curve in Fig. 4 is for a butterfly valve with a maximum valve opening of 60 degrees. The curve indicates that the butterfly valve is basically an equal-percentage valve—that is, equal changes in valve travel result in equal percentage changes in flow. The change in open area of the valve for equal changes in valve travel indicates that the valve does not have an equal-percentage function and that this characteristic does not appear to be justified. However, both the velocity of approach of the fluid as well as the diverting action of the disk, which are both functions of disk position, combine with the area function to influence the shape of the flow characteristic curve, making it an equal-percentage curve.

Like the torque curves in Fig. 1, the curve in Fig. 4 is based on a constant pressure drop across the valve at all



# MOELLER

## INDUSTRIAL THERMOMETERS

. . . Built upon Four Generations of

**GUARANTEED ACCURACY**

- Engineered to meet the exacting demands of modern science and industry.
- Designed with the exclusive, patented Moeller Red Reading Glass for quicker, easier reading.
- Sturdily constructed to assure years of lasting satisfaction.
- Available in 5, 7, 9 and 12 inch cases, with fixed or separate socket connections, in straight and angle form, with any desired scale range.

For 85 years Moeller Products have set the standard of accuracy in the design and manufacture of temperature indicating, measuring and recording instruments.

*Send for catalogs and literature on*

INDUSTRIAL, LABORATORY
AND RECORDING THERMOMETERS
VACUUM GAUGES • HYGROMETERS
HYDROMETERS • PSYCHROMETERS
AND MARINE SPECIALTIES

**MOELLER**
INSTRUMENT COMPANY
132nd ST. and 89th AVE. • RICHMOND HILL 18, N. Y.
*Representatives in Principal Cities*

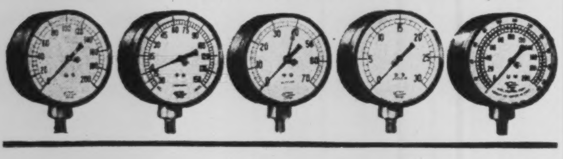
Know the scope of the MARSH line of pressure gauges

There are literally thousands of combinations of types, ranges, case styles and connections in the broad Marsh line of pressure, vacuum and compound gauges. As a result, gauge requirements that would be "special" to others are often standard to Marsh.

This means that we can meet your gauge needs better and more economically . . . whatever the service condition, quantity or design requirement. To know the scope of Marsh Instruments just ask for the new fact-filled catalog.

MARSH INSTRUMENT CO.
Sales affiliate of Jas. P. Marsh Corp., Dept. 42 Skokie, Ill.
Export Dept.: 155 E. 44th St., New York 17, N. Y.

MARSH
Gauges Thermometers
catalog no
VO-M



FASTER . . . EASIER

PRECISION DEW POINT INDICATOR

★ The Alnor is the only dew point indicator that is a complete unit in itself . . . it is readily portable and does not require external coolants or auxiliary apparatus.

★ Controlled testing conditions are assured. Indications take place in an enclosed chamber . . . dew or fog is observed suspended in air—not on a polished surface. This means greater accuracy, faster reading—every time.

★ Simple, direct operation of the Alnor Dewpointer assures laboratory accuracy by non-technical personnel. Substantial carrying case protects it against the usual hazards of portable use.

★ Available in three ranges—for dew points between minus 20 deg. F. and room temperatures, from minus 80 deg. F. to 0 deg. F., and from —80 deg. F. to room temperature.

Write for Descriptive Bulletins. Illinois Testing Laboratories, Room 518, 420 N. La Salle St., Chicago 10, Ill.

Alnor PRECISION INSTRUMENTS FOR EVERY INDUSTRY

angles of opening. Thus it merely illustrates the inherent flow characteristic of the valve and is not representative of the flow characteristic of the valve in the normal system in which the pressure drop across the valve increases as the flow decreases.

A study of Fig. 4 leads to several conclusions regarding butterfly valves than can assist in their correct application. At small angles of opening (less than 20 percent of valve travel) a relatively large percentage change in flow results from a small valve movement. Thus difficult control might be anticipated in this region with most operating devices. On certain types of drive mechanisms having rotary output shafts, reasonably good control can be obtained in this region by employing a special linkage arrangement, or by use of special characterized cam-positioning devices. It is normal practice to size the valve so that, if possible, the minimum flow at which control is required is above 15 degrees open.

The maximum recommended turndown for a butterfly valve is approximately 10 to 1. To get good control beyond this range, a by-pass valve should be used or, as is often done with larger valves, a smaller port is built into a larger disk. With this latter arrangement, separate operating devices are employed for each disk. To avoid operating near the closed position when using a line-size butterfly valve, the valve may be designed with a reduced port, as is done frequently with other types of control valves.

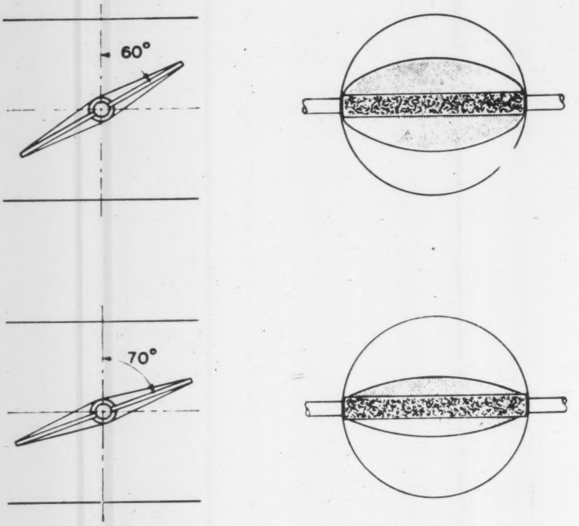
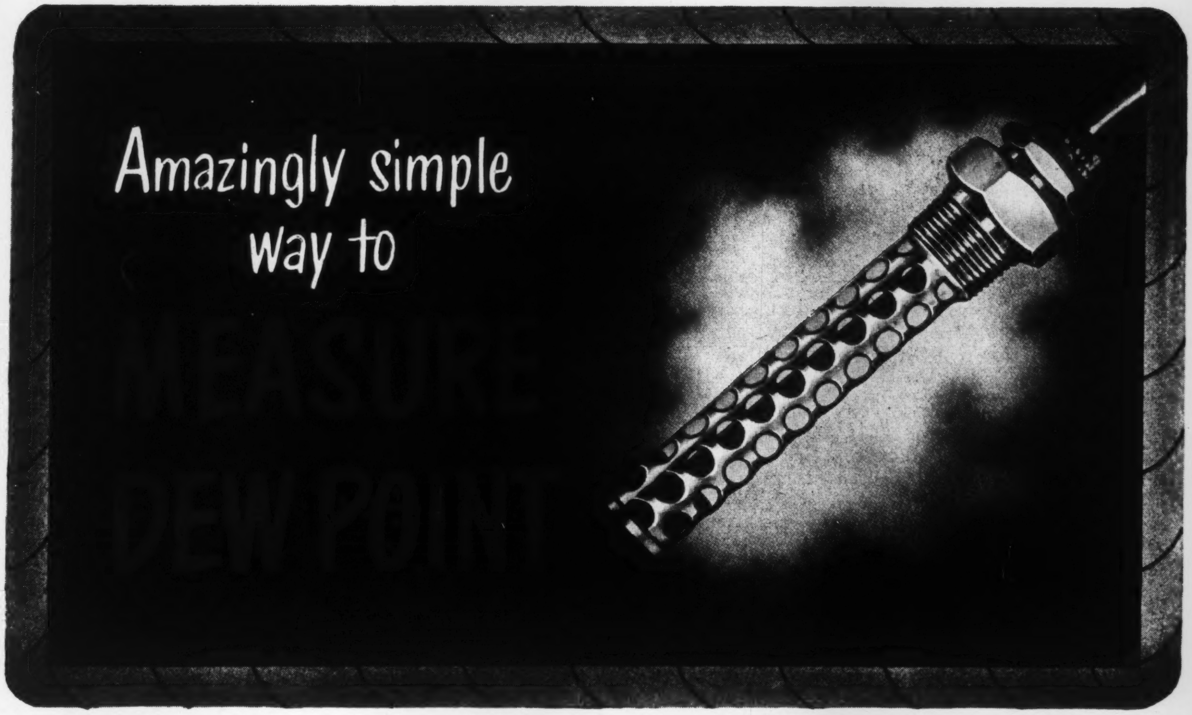


Fig. 5. Variable and dead (or restricted) areas in butterfly valve of normal design at 60 degrees (top) and 70 degrees (bottom).

Butterfly control valves usually are not operated beyond a maximum opening of 60 degrees, and the curve in Fig. 4 was based on this maximum opening. The reason for this restriction is in the design of the valve. A butterfly valve is designed around its main shaft—the shaft diameter being determined by the operating torque requirements and the maximum thrust load on the disk which it supports. Thus the minimum thickness of the disk through its center is established by the diameter of the shaft passing through it and the metal section required to support the load on the disk. This disk thickness determines the maximum open area of the valve. When the valve is opened, the wings of the disk begin to disappear into the profile of its center section. Consequently, at some angle less than 90 degrees open, a limit of the variable area of the valve is reached; no increase in open area will be obtained by further rotation of the disk. The uniformly shaded area in Fig. 5 is the variable area available at 60 and 70 degrees openings in a valve with a 15-percent restricted area. The minimum disk thickness is indicated by the dark irregular shading in the center of the projection. Opening the valve



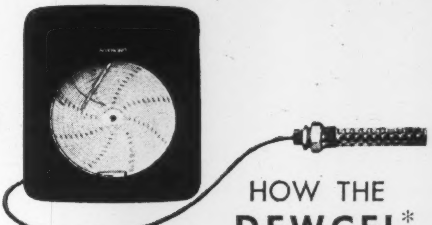
**directly . . . accurately . . . continuously**

Now you can measure or control the humidity content of air or process gases with simplicity and accuracy never before obtainable!

An entirely new-type humidity-sensitive element, the exclusive Foxboro Dewcel*, opens many new possibilities for product improvement in industry. Coupled with a Foxboro Recorder or Controller, the Dewcel offers these outstanding advantages:

1. Direct recording in dew point temperature, at existing pressure.
2. Wide working range — even operates at sub-zero temperatures.
3. Neither adds nor removes water from atmosphere.
4. No water box or circulation of air required.
5. Simplicity that eliminates maintenance.
6. Sustained accuracy within 1°F. to 2°F.
7. Initial and operating economy.

Investigate Foxboro Dew Point Control for your process. In successful use in nuclear fission, pharmaceutical, food and chemical plants, distilleries, photo film production, drying and storage operations. Write for Bulletin 407. **The Foxboro Company, 4612 Neponset Ave., Foxboro, Mass., U.S.A.**



## HOW THE DEWCEL* WORKS

The Dewcel element is a thermometer bulb (liquid-filled or electric-resistance type) jacketed with lithium-chloride-impregnated woven glass tape. Over this are wound two spaced wires connected to an AC source. The lithium chloride absorbs moisture, allowing current to flow, generating heat, and raising the temperature. Equilibrium temperature is reached when vapor-pressure of the moist salt exactly balances that of the surrounding air or gas. The System translates this temperature into direct readings of dew point.

Thus, Foxboro Dew Point Instruments give direct readings or control of dew point from —50°F. to 142°F. at working temperatures from —40°F. to 220°F. Readings easily converted to absolute or relative humidity.

*Trade Mark*

## FOXBORO INSTRUMENTS

FACTORIES IN THE UNITED STATES CANADA, AND ENGLAND

ASCO
HEADQUARTERS FOR SOLENOID VALVES

*Presents*

**3 SMALL GENERAL PURPOSE PACKLESS SHUT-OFF VALVES**

**for**

**AIR, GAS, WATER, STEAM, LIGHT OILS, REFRIGERANTS AND OTHER LIQUIDS**

*With* **7 BIG CONSTRUCTION FEATURES:**

1. Heavy duty construction—only one operating part, and that of stainless steel—insures millions of trouble free operations.
2. Continuous operating speed over 400 cycles per minute.
3. Forged or bar stock brass and stainless steel construction assure freedom from porosity, a prime requirement for high vacuum or liquefied gas applications.
4. Internal parts readily accessible without removing valve body or disturbing electrical connections.
5. Large size conduit boxes can be rotated 360° in plane parallel to pipe line.
6. Positive bubble-tight shut-off with resilient or metal seating.
7. Low power consumption. Continuous duty coils will not overheat.

These three valves are but samples of the comprehensive line offered for instrument control. To thousands of satisfied users, "ASCO" and "Solenoid Valves" are synonymous.

**BULLETIN 8262**
**MIDGET SOLENOID VALVE**
**Normally closed or normally open**
**Standard Voltages: 115, 230 or 440 A-C**
**60 cycles; 115 D-C**

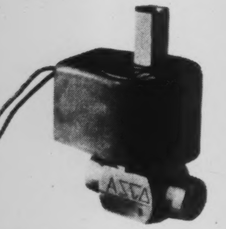
| Body Material | | Brass or Stainless Steel | | | |
|---|---|---|---|---|---|
| Pipe Size (Inches) | | 1/8 | | 1/4 | |
| Port Diameter (Inches) | | 1/16 | 1/8 | 5/32 | 3/16 |
| Maximum Pressure lbs sq. in. | A C | 300 | 130 | 90 | 60 |
| | D C | 250 | 70 | 50 | 30 |

Bulletin 8262 Solenoid Valves may be obtained with by-pass and metering devices. EXPLOSION PROOF AND WATER PROOF HOUSING AVAILABLE. Valves may be installed in any position. Modified Bulletin 8262 Valve with Time Delay can be supplied. Write for literature.

**BULLETIN 8265**
**SOLENOID VALVE**
**Normally closed**
**Standard Voltages: 115, 230, 440 A-C**
**50 or 60 cycles; 115, 230 D-C**

| Body Material | | Brass or Stainless Steel | | |
|---|---|---|---|---|
| Pipe Size (Inches) | | 3/8 | | |
| Port Diameter (Inches) | | 1/8 | 5/32 | 1/4 |
| Maximum Pressure lbs sq. in. | Air and non-corrosive gases | 250 | 125 | 35 |
| | Water, steam, refrig. & liquids to 31 S. S. U. viscosity | 175 | 110 | 35 |
| | Oil and liquids to 70 S. S. U. viscosity | 150 | 80 | 30 |

Bulletin 8265 Solenoid Valves are supplied with stainless steel or resilient type seats—positive seating is assured with either. Standard solenoid housings are for NEMA Type 1 requirements; watertight NEMA Type 4 Housings can be supplied. For steam service, valves are supplied with Class H high temperature glass silicone insulated coils. Send for literature.



**BULLETIN 8314**
**3-WAY SOLENOID VALVE**
**Standard Voltages: 115 or 230 A-C**
**60 cycles; 115 D-C**

| Body Material | | Brass or Stainless Steel |
|---|---|---|
| Pipe Size (Inches) | | 1/8 |
| Port Diameter (Inches) | | 3/16 |
| Max. Pressure lbs. sq. in. | A C | 125 |
| | D C | 50 |

Bulletin 8314 valves may be applied to any 3-way valving requirement regardless of flow directions or pressure application points. The standard valve without any change of springs or other adjustments is suitable for any 3-way control application. These valves may be mounted in any position and will give tight shut-off. Send for literature.

We also manufacture a quality line of specialized controls including Automatic Transfer Switches, Remote Control Switches, Contactors and Relays./v.52.6

**Automatic Switch Co.**
**385-T LAKESIDE AVENUE • ORANGE, NEW JERSEY**

beyond 70 degrees would result in only a small increase in open area.

Fig. 6 shows a valve designed for high pressure-drops; the fixed restriction is 40 percent of the pipe area. At 60 degrees opening the variable area is sufficient to give good control; but there is no variable area at the 70-degree position. Further rotation of the disk would only reduce the turbulence produced by the disk.

As the approach velocity of the fluid is not lost in a butterfly valve, the capacity of the valve when 60 degrees open is greater than that of the same nominal-size plug-type valve at full lift for most sizes. At 90 degrees opening the pressure loss in the butterfly valve is a minimum. This loss, which is a function of valve design and Reynolds' number, normally is approximately 20 percent of the velocity head of the fluid in the pipe. Thus the butterfly valve is ideally suited for the process requiring a control valve which at certain times may be opened to produce a minimum possible pressure loss in the system. It is an established fact that the quality of control obtained from a valve depends on the ratio of the pressure drop across the valve to that of the entire system. This factor must be considered when using a butterfly control valve, just as it is when using other types of control valves.

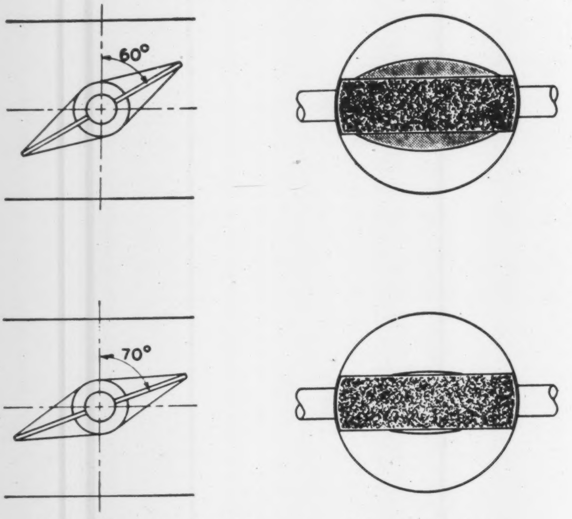
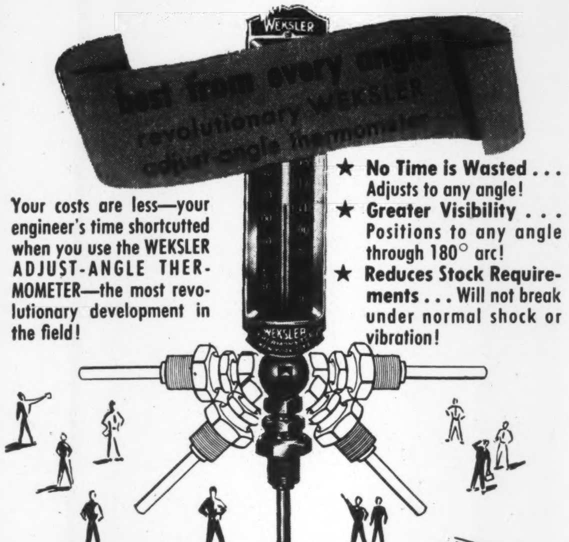


**Fig. 6. Variable and dead areas in a valve of heavy design.**

Installation and service factors (such as pipe fittings adjacent to the valve) that affect the torque characteristics of a butterfly valve also affect its flow and capacity characteristics. The theoretical characteristics will be realized only if the flow approaching the valve is equalized and straightened and if the valve discharges into a straight section of pipe several diameters in length. At flow conditions producing cavitation in liquids, or at flow rates equal to sonic velocity in gases, the capacity of a butterfly valve is reduced from that calculated by the standard coefficients or indicated by sizing rules or flow charts. Correction factors should be applied when sizing valves for these conditions.

## SUMMARY

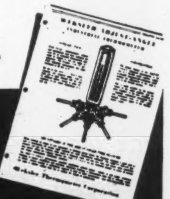
(1) The butterfly valve is not a balanced valve. (2) Although the unbalanced torque always tends to close the valve, the static torque requires that the operating torque be reversed. (3) Both the type and size of operating device used must be carefully selected in the light of the desired performance. (4) The valve is basically an equal-percentage valve with a 10-to-1 turndown range. (5) It has a relatively larger capacity than other types of control valves. (6) Whenever possible, the valve should be installed in a straight run of pipe. (7) Since neither the torque nor flow characteristics are affected by the direction of flow thru the valve, the flow can be in either direction, unless the valve is of some special design.



Your costs are less—your engineer's time shortcutted when you use the WEKSLER ADJUST-ANGLE THERMOMETER—the most revolutionary development in the field!

- ★ **No Time is Wasted . . .** Adjusts to any angle!
- ★ **Greater Visibility . . .** Positions to any angle through 180° arc!
- ★ **Reduces Stock Requirements . . .** Will not break under normal shock or vibration!

*Today—find out how WEKSLER can make things smoother for you Ask your jobber for Important Free Bulletin AA50 or write to:*



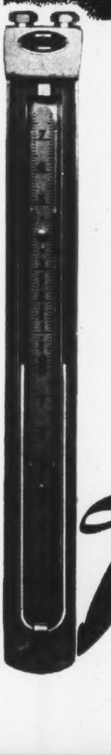
*"Industrial America's Right Arm"*

**WEKSLER THERMOMETER CORPORATION**

*Martinique Bldg*
49 W. 32nd St., New York 1, N. Y.

For Industrial Thermometers Send for **Catalog 125.**
For Glass Engraved on Stem Thermometers and Hydrometers, Send for **Catalog 225.**
For Dial Indicating and Recording Thermometers, Send for **Catalog 325.**
For Dial Indicating and Recording Pressure Gauges, Send for **Catalog 525.**

# ACCURACY
## is built into these sturdy MANOMETERS



### FOR QUICK, EASY READING

***A Trimount Manometer***

*for every purpose—a mounting for every installation*

- **Well Type**
  **Single and Multiple Tube**
- **U tube**
- **Absolute Pressure**
- **Micro Manometers**
- **Inclined Manometers**
- **Draft Gauges**
- **Indicating Flow Meters**
- **Liquid Level Gauges**
- **Electronic Level Control**

***Write for New Illustrated Bulletin E***

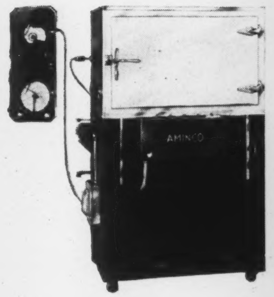
**Trimount INSTRUMENT CO.**

3119 WEST LAKE STREET
CHICAGO 12, ILLINOIS

# Humidity-Temperature TEST APPARATUS

**AMINCO CLIMATE-LAB**

## With Program Control



For testing the performance and durability of materials and devices under specific climatic conditions. Consists of test chamber, air-conditioning unit (Aminco-Aire), and control system, which affords precisely controlled variations of humidity and temperature repeated periodically according to predetermined programs, and provides a chart record of these variations.

## Program Schedules Available

| | | |
|---|---|---|
| JAN-C-20 | JAN-C-372 | SC-D-16286-B |
| JAN-C-25 | JAN-I-6 | ES-D-65103-A |
| JAN-C-62 | JAN-M-745 | MIL-E-5272 (USAF) 4.4.1, Proc. I |
| JAN-C-76 | JAN-R-19 | MIL-E-5272 (USAF) 4.4.2, Proc. II |
| JAN-C-91 | JAN-R-26A | MIL-E-5272 (USAF) 4.4.3, Proc. III |
| | | MIL-M-745-A (Proposed) |

USAF Spec. 41065-B, Grp. 30, Method 31.
Preconditioning state of 50% relative humidity and 77° F.
(Applies to many standard cycles)
Cams for other humidity or temperature programs are available.

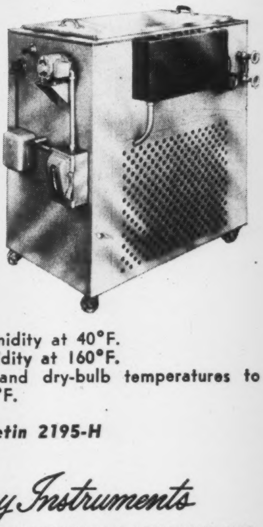
## 4 Types of Humidity-Temperature Control

1. Constant humidity and constant dry-bulb temperature.
2. Constant humidity and varying dry-bulb temperature.
3. Varying humidity and constant dry-bulb temperature.
4. Varying humidity and varying dry-bulb temperature.

***Write for Bulletin 2196-H***

## Aminco-Aire

### A Source of Conditioned Air Precisely Controlled as to Humidity & Temperature



Invaluable for calibrating, processing, assembling, or packaging any device or material which must be handled under precise atmospheric conditions. Available as an individual unit for connection to a test chamber already in your laboratory, or can be supplied with Aminco Test Chambers.

RANGE—82% to 88% relative humidity at 40°F.
9% to 99% relative humidity at 160°F.
ACCURACY—Controls dew-point and dry-bulb temperatures to within plus-minus 1/4°F.

***Write for Bulletin 2195-H***

**AMINCO *Laboratory Instruments***

**AMERICAN INSTRUMENT COMPANY, INC.**
Silver Spring, Maryland • In Metropolitan Washington, D. C.

# Product Index

For more information on any of the following advertised products, simply write the product number on the postage-free card on page 1775.

---

## Temperature

A-100 **Thermometers** Palmer, page 1755
A-101 **Thermometers** Moeller, page 1761
A-102 **Thermometers** Weksler, page 1765
A-103 **Dial Thermometers** Rochester, page 1705
A-105 **Pyrometers** G. E., page 1653
A-106 **Precision Indicators** Lewis, page 1633
A-107 **Thermopiles** Eppley, page 1749
A-108 **Temperature Recorders** Gotham, page 1661
A-109 **Temperature Regulators** Leslie, page 1676
A-110 **Transmitter Gages** U. S. Gauge, page 1665
A-111 **Bolometers** Servo Corp., page 1709
A-112 **Pyrometer Supplies** M-H, page 1656
A-113 **Thermocouple Wire** Gordon, page 1690
A-114 **Thermostatic Bimetals** Chace, page 1695
A-115 **Thermocouple Wells** Trinity, page 1705
A-116 **Porcelain Thermowells** Wheatstone, page 1710
A-117 **Thermistors** Victory, page 1712
A-118 **Thermistors** Friez-Bendix. page 1707
A-260 **Temperature Control** M-H, page 1702

## Pressure

A-119 **Pressure Gages** Acragage, page 1698
A-120 **Pressure Gages** Marsh, page 1762
A-121 **Pressure Gages** Marshalltown, page 1767
A-122 **Precision Dial Manometers** W & T, page 1667
A-123 **Manometers** Meriam, page 1753
A-124 **Standard Pressure Gages** Heise Bourdon, page 1709
A-125 **Pressure, Vacuum Gages** Helicoid, page 1769
A-126 **Manometers** Trimount, page 1765
A-127 **Pressure Pilot** M-H, page 1741
A-128 **Pressure Control** Mercoid, page 1698
A-129 **Miniature Pressure Pickup** Statham, page 1694
A-130 **Pressure Transmitter Gage,** U.S. Gauge, page 1665
A-131 **Pressure Transmitter** Uehling, page 1699

## Leak Detector

A-132 **Leak Detectors** G. E., page 1751

## Process Control

A-133 **Process Control** Taylor, pages 1650-1651
A-134 **Process Control** Hagan, page 1652
A-135 **Process Instrumentation** M-H, pages 1702-1703
A-136 **Process Control** Swartwout, page 1757
A-137 **Controller-recorder** Wheelco, page 1644
A-138 **Controller-recorder** Bristol, pages 1646, 1673
A-139 **Controller-recorder** Gotham, page 1661

## Flow

A-140 **Flow Indicators** S & K, page 1649
A-141 **Flow Rate Integrator** F & P, page 1655
A-142 **Electronic Flowmeter** Potter-Brown, page 1662
A-143 **Ring Balance Flowmeters** Hagan, page 1669
A-144 **Controlled-volume Pumping** Milton Roy, page 1645
A-145 **Flow Tubes** Foster, page 1773
A-146 **Sight Feed Bubbler** Meriam, page 1753
A-261 **Integrating Flow Recorder** M-H, page 1702

## Level

A-147 **Level Gage** Vapor Recovery, page 1682
A-148 **Tank Gage** Uehling, page 1699
A-149 **Level Control** Foxboro, page 1700

## Weight

A-150 **Hydraulic, Pneumatic Weighing** Emery, page 1689
A-151 **Weight Transmitter** Monsell, page 1707

## Combustion

A-152 **Smoke Recorder** Bailey, page 1658
A-153 **Combustion Control** Hays, page 1724
A-257 **Combustion Control** Hagan, page 1652

## Test Chambers

A-154 **Test Chambers** Bowser, page 1634
A-155 **Test Chambers** Webber, page 1696
A-156 **Test Chambers** Murphy & Miller, page 1758
A-157 **Test Chambers** Aminco, page 1765

## Panelboards

A-158 **Panelboards** Falstrom, page 1632
A-159 **Panelboards** Panellit, Inside back cover.

## Air, Drying

A-160 **Drying Equipment** Pgh. Lectrodryer, page 1660
A-161 **Air Compressors** Nash, page 1664
A-162 **Drying Equipment** Industrol, page 1679
A-163 **Drying Equipment** Kemp, page 1767

## Optical

A-164 **Toolmakers' Microscope** Gaertner, page 1699
A-165 **Optical Components** Unertl, page 1708
A-166 **Selenium Photocells** IRC, page 1637

## Chemical and Analytical

A-167 **Gas Analyzer** L & N, page 1674
A-168 **Electrometer, Viewer** Cambridge, page 1751
A-169 **Gas Analyzer** Gow-Mac, page 1755
A-170 **pH Meter** Macbeth, page 1760
A-258 **Infrared Detector** Eppley, page 1749

## Dew Point

A-171 **Dew Point Measurement** Foxboro, page 1763
A-172 **Dew Point Recorder** M-H, page 1702
A-104 **Dew Point Indicator** Illinois, page 1762
A-259 **Psychrometer, Hygrometer** Gotham, page 1661

## Testing and Inspection

A-173 **Hardness Testing** Shore, page 1708
A-174 **Surface Plates** Collins, page 1710

## Valves

A-175 **Valves** Fisher Gov., pages 1628-1629
A-176 **Valves** Kieley & Mueller, pages 1630-1631
A-177 **Valves** M-H, page 1635
A-178 **Valves** Annin, page 1640
A-179 **Relief Valves** MM&M, page 1670
A-180 **Valves** Leslie, page 1676
A-181 **Valves** Atlas, page 1686
A-182 **Valves** Dragon, page 1688
A-183 **Relief Valves** Farris Eng., page 1691
A-184 **Flexible Valves** Farris Flex., page 1693
A-185 **Valves** Rockwell, page 1746
A-186 **Solenoid Valves** Automatic Switch, page 1764
A-187 **Valves** Hammel-Dahl, Back Cover

## Tubing and Fittings

A-188 **Tubing Fittings** Parker, pages 1638-1639
A-189 **Aluminum Tubing** Alcoa, page 1750

## Recorders

A-190 **Potentiometer Recorders** Weston, page 1636
A-191 **Recording Systems** Sanborn, page 1639
A-192 **Strip-chart Recorder** Wheelco, page 1644
A-193 **Oscilloscope Cameras** Fairchild, page 1671
A-194 **Chart Recorders** Bristol, pages 1646, 1673
A-195 **Recording Oscillograph** Century Geo., page 1685
A-196 **Recording Oscillograph** Brush, page 1713
A-197 **Potentiometer Recorders** L & N, page 1742
A-198 **Recording Oscillograph** Midwestern Geo., page 1759

## Counters

| | | |
|---|---|---|
| A-199 | **Counters** | Veeder-Root, page 1666 |
| A-200 | **Electronic Counters** | Berkeley, page 1687 |
| A-201 | **Counters** | Dittmore & Freimuth, page 1775 |

## Electronic Test Instruments

| | | |
|---|---|---|
| A-202 | **Test Equipment** | Hewlett Packard, page 1641 |
| A-203 | **Frequency Standards** | American Time, page 1648 |
| A-204 | **Oscillograph-voltmeter** | DuMont, page 1654 |
| A-205 | **Volt-Ohm-Mil-Ammeter** | Triplett, page 1663 |
| A-206 | **Pulse Oscilloscope** | Waterman, page 1680 |
| A-207 | **Signal Generators** | Measurements, page 1706 |
| A-208 | **Impedance Bridge** | Brown E-M, page 1708 |

## Electrical & Electronic Instruments

| | | |
|---|---|---|
| A-209 | **Data Plotter** | Electronic Assoc., page 1659 |
| A-210 | **Electrical Panel Indicators** | Weston, page 1668 |
| A-211 | **Galvanometers** | G-M Labs., page 1696 |
| A-212 | **Power Supplies** | Lambda, page 1698 |
| A-213 | **Thermistor Power Supply** | Servo Corp., page 1709 |
| A-214 | **Ruggedized Panel Indicators** | Sun Electric, p. 1748 |

## Speed and Timing

| | | |
|---|---|---|
| A-215 | **Tachometers** | Amthor, page 1704 |
| A-216 | **Running Time Meter** | Burlington, page 1704 |
| A-217 | **Synchronous Timing Motors** | Telechron, page 1758 |

## Electrical and Electronic Components

| | | |
|---|---|---|
| A-218 | **Transistors** | Federated Semi., page 1681 |
| A-219 | **Selenium Photocells** | IRC, page 1637 |
| A-220 | **Thermistors** | Friez-Bendix, page 1707 |
| A-221 | **Thermistors** | Victory, page 1712 |
| A-222 | **Displacement Pickups** | Colvin, page 1749 |
| A-223 | **Linear Motion Pot Pickups** | Bourns, page 1771 |
| A-224 | **High-voltage Resistors** | SS White, page 1711 |
| A-225 | **Multi-turn Pots** | Giannini, page 1647 |
| A-226 | **Multi-turn Pots** | Borg, page 1710 |
| A-227 | **Ten-turn Dial** | Borg, page 1711 |
| A-228 | **Ten-turn Dial** | Helipot, page 1755 |
| A-229 | **Dial Lights** | Dial Light Co., page 1752 |
| A-230 | **Hermetic Seal Connectors** | Cannon, page 1683 |
| A-231 | **Cables, Connectors** | Amphenol, page 1774 |
| A-232 | **Permanent Magnets** | Carboloy-GE., pp. 1642-1643 |
| A-233 | **Magnetic C Cores** | Arnold, page 1672 |
| A-234 | **Relays** | Automatic Electric, page 1697 |
| A-235 | **Mercury Switches** | Mercoid, page 1698 |
| A-236 | **Instrument Switches** | Daven, page 1700 |

## Engraving and Marking

| | | |
|---|---|---|
| A-237 | **Engraver** | Mico, page 1698 |
| A-238 | **Engraver** | New Hermes, page 1704 |
| A-239 | **Marking** | Acromark, page 1706 |
| A-240 | **Engraving, Marking** | Green, page 1760 |

## Shop Equipment

| | | |
|---|---|---|
| A-241 | **Soldering Iron** | Hexacon, page 1701 |
| A-242 | **Torque Wrenches** | Sturtevant, page 1706 |
| A-243 | **Mercury, Cleaners** | Bethlehem, page 1749 |
| A-244 | **Precision Drill Press** | Levin, page 1751 |

## Instrument Components

| | | |
|---|---|---|
| A-245 | **Precision Tubing** | Superior Tube, page 1657 |
| A-246 | **Precision Metalworking** | Steinen, page 1684 |
| A-247 | **Nameplates, Dials** | U. S. Radium, page 1772 |

## Consultants and Markets

| | | |
|---|---|---|
| A-248 | **Consultant Service** | Fluid Controls, page 1776 |
| A-249 | **Consultant Service** | Jacobs Assoc., page 1776 |
| A-250 | **Overseas Business** | Machinery Lloyd, page 1754 |
| A-251 | **Instruments Index** | Instruments, page 1747 |

## Positions Available

| | | |
|---|---|---|
| A-252 | **Position** | North American, page 1678 |
| A-253 | **Position** | Electric Auto-Lite, page 1746 |
| A-254 | **Position** | Johnson Eng., page 1712 |
| A-255 | **Position** | Box 227, page 1712 |
| A-256 | **Position** | Box 228, page 1746 |

**Stop Moisture Damage**

- QUICKLY
- ECONOMICALLY
- EFFICIENTLY

*KEMP DYNAMIC DRYERS DRY INSTRUMENT AIR TO SUB-ZERO DEW POINTS FOR AS LOW AS ¼c PER MCF*

You can count on Kemp to protect *your* costly air operated instruments against moisture damage. Available in a wide variety of designs and models, each Kemp Dryer is *guaranteed* to perform to *your* specifications. Better check Kemp before you buy!

**KEMP**
*OF BALTIMORE*

*DYNAMIC DRYERS*
Write for Bulletin D-27 for technical information. C. M. KEMP MFG. COMPANY, 405 E. Oliver Street, Baltimore 2, Maryland.

CARBURETORS • BURNERS • FIRE CHECKS • ATMOSPHERE GENERATORS • ADSORPTIVE DRYERS • METAL MELTING UNITS SINGEING EQUIPMENT • SPECIAL EQUIPMENT

10
20
30
40
50
60
70
80
90
100

**THE RIGHT GAUGE FOR YOUR SPECIFIC NEEDS**

**MARSHALLTOWN**

- Available in a wide variety of general purpose and special purpose gauges in pressure ranges to meet your specifications in every particular.

WRITE TODAY FOR COMPLETE INFORMATION

PRESSURE, VACUUM, COMPOUND, ALTITUDE, COMBINATION, DIAPHRAGM, HYDRAULIC, AND SPECIAL PURPOSE GAUGES, DIAL THERMOMETERS, (VAPOR TENSION OR BI-METAL)

MARSHALLTOWN MFG. CO.
800 EAST NEVADA ST. • MARSHALLTOWN, IOWA

# Manufacturers' New Literature

**In this department we report new literature, pertaining to instrumentation, received from the manufacturers. We urge readers to request ONLY those bulletins which will be of value to them. Use the Postage-free Order Card on Page 1775.**

**Requests for literature FROM ABROAD should be made on company letterhead and mailed DIRECTLY to the manufacturers.**

---

## Temperature

U-1197 **Temperature Recorders.** New 20-page illustrated Bulletin 447 covers maker's line of filled-thermal-system temperature recorders. Includes installation, features, thermal system charts, and accessories; also comparisons of vapor-pressure, gas-pressure, and liquid-expansion systems.—The Foxboro Co., Foxboro, Mass.

U-1198 **Precision Potentiometers.** New 12-page catalog EH22(3) covers maker's "White" line of single and double potentiometers for precision calorimetry. Includes design, construction, and applications. Discussed potentiometer principles in detail.—Leeds & Northrup Co., 4907 Stenton Ave., Phila. 44, Pa.

U-1199 **Thermocouples.** New 4-page Bulletin TC-1 illustrates and describes maker's complete line of bare-wire thermocouples with gland for sealing bare wires at pressures from full vacuum to 15,000 psi. Includes principle of seal, construction, and specifications.—Conax Corp., 4515 Main St., Buffalo, N. Y.

U-1200 **Temperature Controllers.** New 4-page Specification Sheet 612 illustrates and describes maker's indicating and recording filled-system thermometers with pneumatic control. Includes construction, engineering details, styles and ranges.—Minneapolis-Honeywell Regulator Co., Brown Instruments Div., Sta. 64, Wayne & Windrim Aves., Phila. 44, Pa.

U-1201 **Temperature Controller.** New 2-page Bulletin 3M illustrates and describes maker's "Sterlco 150E" self-operated controller with filled thermal system and bellows-sealed valve for industrial uses. Includes features and operation.—Sterling, Inc., 3738 N. Holton St., Milwaukee 12, Wis.

U-1202 **Temperature Controller.** New 4-page Bulletin 551 illustrates and describes maker's self-contained unit that pre-heats and maintains proper mold temperatures by heating and cooling circulating water. Includes features, applications, construction, and specifications.—Sterling, Inc., 3738 N. Holton St., Milwaukee 12, Wis.

## Pressure

U-1203 **Pressure Regulators.** New 28-page illustrated Catalog 350 describes and gives specifications of maker's self-operated pressure and temperature regulators, valves, and strainers. Also includes capacity and flow data, dimensions, and weights and flange standards.—Spence Engineering Co., Inc., Walden, N. Y.

U-1204 **Pressure Pickup.** New 6-page Bulletin 1534 illustrates and describes new "Type 4-310" flush-diaphragm strain-gage-type pressure-pickup for either liquid or gas, a-c. or d-c. systems. Includes uses, features, and operating characteristics.—Consolidated Engineering Corp., 300 North Sierra Madre Villa, Pasadena 15, Calif.

U-1205 **Pressure Pickup.** New 3-page data bulletin describes maker's new electrokinetic pressure transducer "Type 3" which uses streaming potential developed by flow of polar liquid through porous plug, and which has operating pressure range from $10^{-4}$ to 100 psi. Includes features and specifications.—The Beta Corp., P. O. Box 8625, Richmond 26, Va.

U-1206 **Pressure Switches.** New Catalog M-10-52 illustrates and describes maker's diaphragm-actuated pressure switches "Series 451," available to make or break 5 amperes, and operated at any absolute or differential pressure up to 40 psi.—Colvin Laboratories, 12 Court St., Morristown, N. J.

U-1207 **Vacuum Equipment.** New 6-page Bulletin 12-K illustrates and describes maker's high-vacuum pumps and accessories, blow torches, gas burners, pipe-line regulators, valves and glass-blowing equipment. Includes construction and features.—Research Vacuum Supply Co., 3434 Montrose Ave., Chicago 18, Ill.

U-1208 **Cylinder-pressure Indicator.** New 4-page booklet illustrates and describes maker's new "CPI" cylinder pressure indicator for GM series 71 engines. Gives instructions and features.—Bruce Instrument Co., 2767 13th Ave. S.W., Seattle 4, Wash.

U-1209 **Pressure Tester.** New Bulletin 62 illustrates and describes maker's total pressure-tester, an accurately calibrated, self-contained hydraulic unit. Includes capacities and dimensions.—Studebaker Machine Co., 1128 S. 9th Ave., Maywood, Ill.

## Flow and Proportioning

U-1210 **Flowmeters.** New 16-page Bulletin 1000 illustrates and describes maker's complete line of flowmeters, transmitters, and controllers for industrial use, giving construction and features. Includes article on modern design of power-plant instrumentation.—Penn Industrial Instrument Corp., Penn Bldg., 4110 Haverford Ave., Phila. 4, Pa.

U-1211 **Area Meter.** New 4-page Bulletin 233-A illustrates and describes maker's area meter for measuring rate of flow. Includes principle of operation, features and specifications.—Bailey Meter Co., 1050 Ivanhoe Rd., Cleveland 10, Ohio.

U-1212 **Flowmeter.** New 4-page Bulletin 704 illustrates and describes a pneumatic-electric flowmeter for measuring widely fluctuating flows, dirty fluids, and other difficult fluids. Hook-ups, meter components, and applications are discussed and illustrated.—Republic Flow Meters Co., 2240 Diversey Pkwy., Chicago 47, Ill.

U-1213 **Proportioning, Feeding, and Controlling Equipment.** New 8-page Bulletin BIF-3 illustrates and describes large line of chemical proportioning equipment by Proportioneers, volumetric and gravimetric feeders by Omega Machine, and flowmeters and industrial controllers by Builders.—B-I-F Industries, P. O. Box 1342, Providence 1, R. I.

U-1214 **Feed Regulators.** New 4-page Technical Bulletin 7 illustrates and describes maker's electronic feed regulators for mechanical and vibrating feeders on pulverizers and other processing equipment. Details, principles, operation, and construction.—Mosher Electronic Controls, 130 W. 42nd St., New York 18, N. Y.

## Level

U-1215 **Tank Gage.** New 12-page brochure illustrates and describes new "Pacitron" electronic tank gage that measures fuel in tank by change in capacitance of small tank unit. Includes principles, circuit schematic, operation, advantages, units, accessories for totalizing and compensating, and applications.—Simmonds Aerocessories, Inc., Tarrytown, N. Y.

U-1216 **Liquid-level Indicators.** New 2-page Bulletin 7090 illustrates and describes maker's new miniature liquid-level and valve-position indicators for graphic-panel use. Includes operation, features, specifications and characteristics.—Minneapolis-Honeywell Regulator Co., Brown Instruments Div., Sta. 64, Wayne & Windrim Aves., Phila. 44, Pa.

U-1217 **Bin Level Control.** New 4-page brochure illustrates and describes maker's capacitance-type electronic bin or tank level control. Includes operation, construction, and features.—Mosher Electronic Controls, 130 W. 42nd St., New York 18, N. Y.

## Process Control

U-1218 **Process Instruments.** New 8-page Bulletin 17-D illustrates and describes maker's large line of instruments and controllers for process industries. Includes principles and features of basic measurement techniques for temperature, pressure, flow, level, telemetering, smoke density, and gas analysis. Various control systems, mul-

**See pages 1766-1767 for classified list of advertised products.**

ti-element systems, and electronic instruments are described.—Bailey Meter Co., 1050 Ivanhoe Rd., Cleveland 10, Ohio.

U-1219 **Automatic Control.** New issue No. 291 of the "Industrial Bulletin" includes article on automatic control, its development, advantages, and uses plus other articles of industrial interest. —Arthur D. Little, Inc., Cambridge, Mass.

U-1220 **Process Instruments.** 32-page Bulletin 427-1 illustrates and describes maker's complete line of "Dynalog" electronic indicators, recorders, and controllers for process variables. Gives features, applications, principles, and specifications.—The Foxboro Co., Foxboro, Mass.

U-1221 **Pneumatic Positioning Operator.** New 4-page Bulletin S-15 illustrates and describes maker's pneumatic positioning operator for high-speed positioning and regulating of heavy equipment. Describes operation of valve and mechanism which enable operator to overcome starting friction and inertia. Includes dimensions.—Republic Flow Meters Co., 2240 Diversey Pkwy., Chicago 47, Ill.

## Water and Moisture

U-1222 **Dehydrators.** New 12-page illustrated Bulletin SC-1013 describes maker's 3 series of dehydrators, including capacities and physical dimensions. Discusses applications, operation principles, features, and dehydrator nomograph for saturated gases under pressure.—Selas Corp. of America, Phila. 34, Pa.

U-1223 **Moisture Meter.** Four new 2-page brochures illustrate and describe maker's moisture meter and show applicability to textile field, paper mill, or powdered and bulk materials.—Hart-Moisture-Meters, Grand Central Terminal, New York 17, N. Y.

U-1224 **Waste Treatment.** New 8-page illustrated Bulletin BIF-4 covers types, principles, methods, techniques, and equipment for all types of industrial waste treatment. Includes three tables covering entire field.—B-I-F Industries, P. O. Box 1342, Providence 1, R. I.

## Speed and Vibration

U-1225 **Tachometers.** New 20-page illustrated Bulletin S1402 describes maker's full line of recording and indicating electric tachometers. Includes engineering information, specifications, applications, chart records, and dimensions.—The Bristol Co., Waterbury 20, Conn.

U-1226 **Vibration Analysis.** New 4-page brochure illustrates and describes maker's "Model 652 Vibratron" for analysis and correction of vibration. Includes construction, operation, and features.—International Research & Development Corp., Columbus, Ohio.

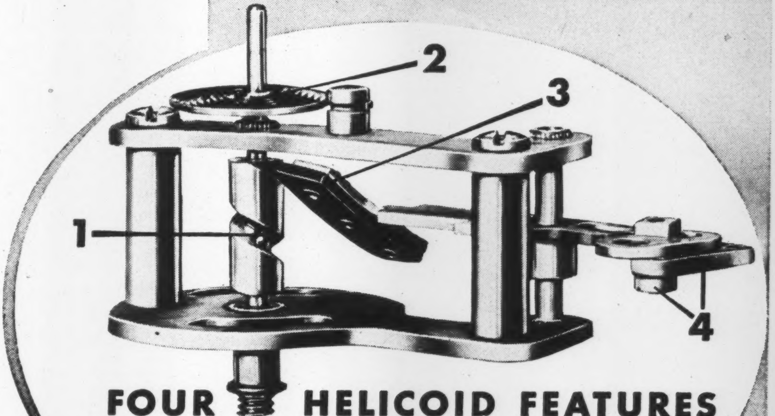
U-1227 **Speed Changers.** New 4-page Bulletin 100 illustrates and describes two series of maker's miniature fixed-ratio speed changers for gearing problems in all low-power devices.—Metron Instrument Co., 432 Lincoln St., Denver 9, Colo.

an **ACCO** product

**HELICOID**

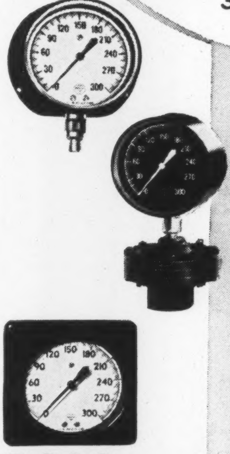
***The gage that retains its original accuracy longer, lasts longer, costs less per gage, per year***

The greatest achievement of the gage makers' craft—pressure gages without gears. The Helicoid movement... tested and proved in years of hard service... is a simple cam and roller arrangement that gives long, trouble-free service.



**FOUR HELICOID FEATURES**

1. Stainless Steel Helicoid Roller (no gear teeth)
2. Stainless steel hair spring
3. Long Life Cam (no gear teeth)
4. Corrosion Resistent link and screws



• HELICOID GAGES, which do not have gear teeth to wear out, are made in a full range of pressures... in various sizes and shapes, with black, white and radiant faces. For wall or stem mounting, flush or panel mounting, or flangeless. No finer gages are made. Helicoid Gages cost less in the long run.

*Write today*
for the Helicoid
Gage catalog.

**HELICOID**
Pressure
•
Vacuum
**GAGES**

ACCO
TRADE MARK

HELICOID GAGE DIVISION
**AMERICAN CHAIN & CABLE**
927 Connecticut Avenue • Bridgeport 2, Connecticut

# NEW LITERATURE

## Combustion

U-1228 **Combustion Control.** New 8-page Bulletin 103 covers the three basic elements of "Robot-Eye" combustion control. Describes operation, features, and installations; discusses use of haze as a combustion index.—General Power Plant Corp., 381 4th Ave., New York 16, N. Y.

## Chemical Laboratory

U-1229 **Laboratory Equipment.** New 4-page Bulletin 13 M illustrates and describes over 15 laboratory items, including manometers, bottles, flexible heating tape, etc. Includes features and applications.—E. Machlett & Son, 220 E. 23rd St., New York 10, N. Y.

U-1230 **Laboratory Mixers.** New 8-page folder illustrates and describes 4 models of maker's laboratory mixers. Includes specifications, features, applications, and accessories.—Gardner Laboratory, Inc., Bethesda, Md.

## Analytical

U-1231 **Spectrophotometers, Colorimeter, Radioactivity.** New 16-page illustrated Bulletin 300 describes maker's line of precision spectrophotometers for analysis in infrared and visible region. Also described are pH meters, flow colorimeters, radiation instruments, micromicroammeters, and other special instruments. Includes construction, applications, and features.—Beckman Instruments, Inc., 820 Mission St., S. Pasadena, Calif.

U-1232 **Infrared Analyzer.** New 4-page Instrumentation Data Sheet 10. 16-7a illustrates and describes maker's selective infrared analyzer for plant-stream service. Includes operation, application, features and uses.—Minneapolis-Honeywell Regulator Co., Brown Instruments Div., Sta. 64, Wayne and Windrim Aves., Phila. 44, Pa.

U-1233 **Gas and Vapor Analysis.** New 30-page illustrated booklet "Methods and Instruments for the Continuous Analysis of Gases and Vapors" covers principles, techniques, and applications of catalytic-combustion types, thermal-conductivity types, and electro-conductivity types of gas and vapor continuous analyzers. Includes equipment descriptions and bibliography.—Davis Instruments, 47 Halleck St., Newark 4, N. J.

U-1234 **Gas Alarm.** New 8-page illustrated Technical Bulletin 11-36 describes maker's filament-type combustible-gas alarm systems that use catalytic-combustion principle. Includes principle of operation, construction, accessories, and specifications.—Davis Instruments, 47 Halleck St., Newark, N. J.

U-1235 **Electro-Analyzer.** New 6-page Bulletin 390 illustrates and describes construction, operation, and applications of maker's ultra-speed electro-analyzer for determination of copper and lead in alloys.—Eberbach Corp., Ann Arbor, Mich.

U-1236 **Comparator Densitometer.** New 8-page illustrated issue Vol. 3, No. 3 of "Better Analysis" contains article on new comparator densitometer. Other articles discuss use of "Direct Reader" spectrographic analytical units in quality control by Copperweld Steel and Hughes Tool Co.—Baird Associates, Inc., 33 University Rd., Cambridge 38, Mass.

U-1237 **pH Comparators.** New 96-page handbook (Tenth Edition) entitled "Modern pH and Chlorine Control" illustrates and describes maker's line of comparators, chlorimeters, and water analyzers used in pH determination by colorimetric comparison. Includes construction, replacement parts, and operation.—W. A. Taylor & Co., 7300 York Rd., Baltimore 4, Md.

U-1238 **pH.** New 2-page bulletin illustrates and describes maker's portable pH meter "Model 125" in which three radio batteries give 2000-hr. service.—Photovolt Corp., 95 Madison Ave., New York 16, N. Y.

## Optical

U-1239 **Plenary Microscope.** New 12-page bulletin illustrates and describes maker's new plenary microscope, a versatile photomicrographic unit with incubator, camera, projection features, etc. Gives construction, features, and applications.—Lovins Engineering Co., 8203 Cedar St., Silver Spring, Md.

U-1240 **Optical Instruments.** New 8-page Catalog D-22 illustrates and describes maker's optical instruments for quality control, including contour measuring projectors, stereomicroscopes, and thickness gages for industrial use. Includes features and applications.—Bausch & Lomb Optical Co., Rochester 2, N. Y.

U-1241 **Microphotometer.** New 4-page brochure illustrates and describes maker's microphotometer for use in conjunction with microscope. Includes applications, special features, construction and details on calibration procedure.—Paul Rosenthal, 505 Fifth Ave., New York 17, N. Y.

## Surface Roughness

U-1242 **Surface Roughness.** New 4-page illustrated Form L21 "How to Specify Surface Roughness—and Why" covers definitions, terminology, techniques, and instruments for measurement of surface roughness.—Micrometrical Mfg. Co., 345 S. Main St., Ann Arbor, Mich.

U-1243 **Surface Comparator.** New 4-page Bulletin 2A-PP-352 illustrates and describes maker's portable surface comparator with roughness range from 1 to 100 microinches rms. Includes features of construction, operation, and specifications.—Kota-Meters, Inc., 2311 Burbank St., Dallas 19, Texas.

## Snap Gages, Comparators

U-1244 **Gages and Comparators.** New 28-page Catalog C illustrates and describes maker's dial snap gages, bore gages, plug gages, and others in complete line of gaging instruments. Includes features, applications, and specifications.—Standard Gage Co., Inc., Poughkeepsie, N. Y.

U-1245 **Gages and Comparators.** New 36-page brochure illustrates and describes maker's "Nilco" line of dial bore gages, snap gages, and groove gages. Includes applications, features, construction, and range for each model. —Nilsson Gage Co., Poughkeepsie, N. Y.

## Strain and Hardness

U-1246 **Testing-machine Accessories.** New 24-page Bulletin 46 illustrates and describes maker's electronic recorders, mechanical extensometers, electronic strain instrumentation, and many other tools and accessories for testing machines.—Tinius Olsen Testing Machine Co., Easton Rd., Willow Grove, Pa.

U-1247 **Universal Testing Machines.** Data Sheet 6-1952 illustrates and describes maker's "U-40" and "U-60" universal testing machines for tension, compression, and bending. Includes features and applications.—Ann Arbor Instrument Works, Ann Arbor, Mich.

U-1248 **Metal Hardness Tester.** New 8-page brochure illustrates and describes maker's portable metal-hardness tester scaled in Rockwell A, B, or C or Brinell low or medium ranges. Includes features and principle of operation.—Newage International, Inc., 235 E. 42nd St., New York 17, N. Y.

## Radioactivity

U-1249 **X-ray Supplies.** New 104-page 1953 edition of "Accessories and Supplies" lists, illustrates, and describes maker's large line of X-ray supplies (films, chemicals, opaques, cassettes, viewing equipment, etc.) essential to industrial radiography.—The Keleket X-ray Corp., 254 W. 4th St., Covington, Ky.

U-1250 **X-ray Thickness Gage.** New 16-page Catalog MY-52-3 illustrates and describes maker's new "Measuray" non-contact X-ray gage for continuous measurement of strip or sheet stock. Includes features, operation, applications, and specifications.—The Sheffield Corp., Dayton 1, Ohio.

U-1251 **X-ray-generator Maintenance.** New 11 x 15 inch chart is trouble chart for locating and repairing common electrical faults in X-ray generators.—North American Philips Co., Inc., 750 S. Fulton Ave., Mount Vernon, N.Y.

U-1252 **Radiation Detection, Reactor Control.** New 16-page illustrated Price List 12 describes maker's radiation detection and health instruments, proportional and scintillation Geiger counters, shields and safety devices. Also complete reactor-control instrumentation. Includes page of terminology.—Dept. FP-11, Radiation Counter Laboratories, Inc., 5122 W. Grove St., Skokie, Ill.

## Counters

U-1253 **Counter Applications.** New 32-page booklet illustrates and describes basic applications of direct-reading digital counters. Covers high-speed counting, counting plus control, precise interval timing, measurement of rpm., pressure, temperature, flow, viscosity, velocity, frequency, distance, etc.—Berkeley Scientific Div., Beckman Instruments, Inc., 2200 Wright Ave., Richmond, Calif.

## Valves

U-1254 **Coke-oven Gas Valve.** New 4-page Specification Sheet 421 illustrates and describes maker's "Series 700" coke-oven gas valve with special knife-edge plug to cut gummy deposits. Includes construction, body temperature-pressure ratings, and mounting dimensions.—Minneapolis-Honeywell Regulator Co., Brown Instruments Div., Sta. 64, Wayne and Windrim Aves., Phila. 44, Pa.

U-1255 **Slip-stem Regulating Valves.** New 4-page Specification Sheet 422 illustrates and describes maker's "Type-31" double-seated slip-stem regulating valves for on-off or narrow-band proportional control. Includes construction, body temperature ratings, and mounting dimensions.—Minneapolis-Honeywell Regulator Co., Brown Instruments Div., Sta. 64, Wayne and Windrim Aves., Phila. 44, Pa.

U-1256 **Servo Valve.** New 4-page Brochure 4 illustrates and describes maker's "PC-1" pressure-control servo valve for use at high power levels. Includes pneumatic and electrical specifications and response curves for hysteresis and frequency response.—Standard Controls, Inc., 1431 23rd Ave. South, Seattle 44, Wash.

U-1257 **Valved Couplers.** New 2-page Catalog A 718 illustrates and describes maker's new "Wave-Flow Quick-Couplers" for quick coupling of pneumatic and hydraulic lines. Includes features and applications.—Henry Valve Co., 3215 North Ave., Melrose Park, Ill.

## Tubing

U-1258 **Cable Trough.** New 12-page Bulletin 65A illustrates and describes maker's complete line of expanded metal cable trough for supporting cables, tubing, etc. Includes construction, tracing templates, load deflection data and installations.—T. J. Cope, Inc., 711 S. 50th St., Phila. 43, Pa.

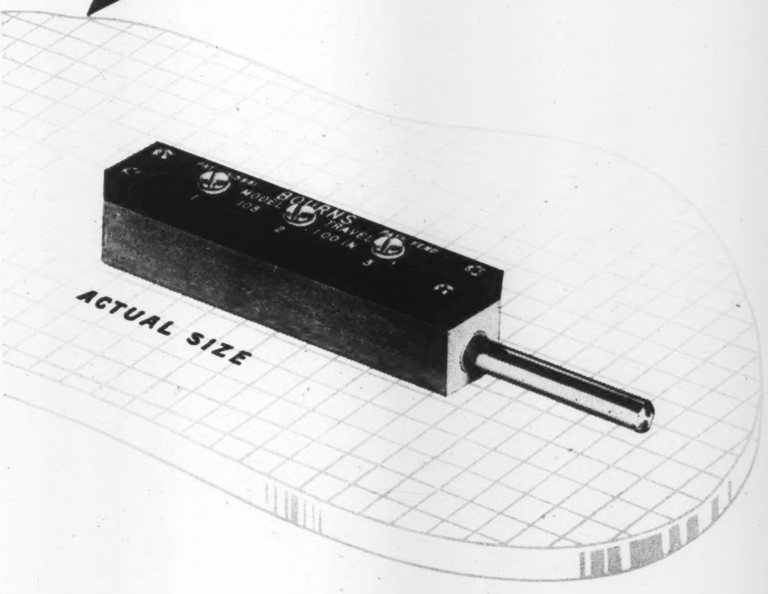
U-1259 **Reinforced Plastic Tubing.** New Brochure 468C illustrates and describes maker's flexible plastic tubing with stainless-steel-braid reinforcement. Includes characteristics and features. —The U. S. Stoneware Co., Akron 9, Ohio.

U-1260 **Flexible Plastic Tubing.** New 24-page Catalog T-77 illustrates and describes maker's large line of "Tygon" plastic tubing. Includes properties of six standard formulations, characteristics, features, and applications in research and industry.—U. S. Stoneware Co., Akron 9, Ohio.

## Recorders

U-1261 **Strip-chart Recorders.** New 44-page Catalog 1520 illustrates maker's strip-chart recorders and other "ElectroniK" non-control precision instruments. Includes specifications and data on specially adapted "ElectroniK" instrument—electrometer, function plotter, etc.—Minneapolis-Honeywell Regu-

BOURNS



LINEAR MOTION POTENTIOMETERS

BOURNS precision wire-wound potentiometers accurately translate mechanical position into an electrical signal. Resolution of .001 inch attainable in all standard ranges from 1 to 6 inches. Technical publication describing standard models and special applications available upon request.

BOURNS designs and manufactures other potentiometer instruments which measure such physical variables as gage pressure, differential pressure, altitude and acceleration.

BOURNS LABORATORIES
6135 MAGNOLIA AVENUE • RIVERSIDE, CALIFORNIA

RADIO
TALK MONITOR A B
SOUND POWER
MONITOR A B TALK
INDICATOR
BRIDGE UNIT
NE
E
SE
S
ROTATION
CHANNEL SELECTOR

DIALS OR NAMEPLATES OF ANY TYPE

—at savings that will surprise you!

Because of our company name, you may think of U. S. Radium Corporation as a source of only *luminous* dials or nameplates. Actually we make self-luminous, fluorescent, phosphorescent, and *non*luminescent types, including Alumilite, lithographed or etched aluminum, brass, steel, or stainless steel — finished in lacquer, nickel, chromium, or silver — with black, color, or luminescent markings. In other words, you name it — we make it!

Moreover, having produced millions of dials and nameplates for all kinds of instruments, timepieces, and other uses, we've learned to combine mass-production techniques with our traditional standards of accuracy and fine quality. Result: you get exactly the dials or nameplates you want — at lower costs than you are likely to think possible.

We are, of course, equipped to meet Government specifications . . . and to produce large quantities of routine-type dials or nameplates, or small runs of special, high-accuracy scientific ones.

To find out how we can provide your apparatus with better-designed or lower-cost dials or nameplates, write to Department I-12, United States Radium Corporation, 535 Pearl Street, New York 7, New York.

*Other Products of U. S. Radium*

**RADIOACTIVE FOILS**
(alpha-ray ionization sources)
**IONOTRON STATIC ELIMINATORS**
**RADIUM LOCATORS:**
lenses, buttons, screws, markers
**LUMINOUS RETICLES**
and other specialties

**POWDERS:**
cathode-ray tube and television tube
**SILHOUETTE ILLUMINATION**
of clocks, watches, and instruments
**RADIATION MATERIALS:**
radiation, neutron, and standard-light sources

US RADIUM

**UNITED STATES RADIUM CORPORATION**

BETTER DIALS AND NAMEPLATES AT LOWER COST

lator Co., Brown Instruments Div., Sta. 64, Wayne & Windrim Aves., Phila. 44, Pa.

U-1262 **Recording Potentiometer.** New 2-page Specification Sheet 179 illustrates and describes maker's new "Electronik" strip-chart potentiometer with two-second full-scale pen travel. Includes features and dimensions.—Minneapolis-Honeywell Regulator Co., Brown Instruments Div., Sta. 64, Wayne & Windrim Aves., Phila. 44, Pa.

U-1263 **Recording Systems.** New 6-page Folder 13M illustrates and describes applicability of maker's direct-writing recording systems for a large number of variables. Includes performance data, specifications, and advantages of interchangeability of amplifiers and preamplifiers. Includes discussion of pickups, amplifiers, and recorders.—Sanborn Co., 39 Osborn St., Cambridge 39, Mass.

U-1264 **Recorders.** 16-page Bulletin 23M "7 Advantages of Sanborn direct-writing Recorders" illustrates and describes many industrial uses.—Sanborn Co., 38 Osborne St., Cambridge, Mass.

## Radio, Telemetering, TV

U-1265 **Radiotelephones, Direction Finders.** New 8-page illustrated Form 852 describes 8 models of maker's radiotelephones for communication from 18 to 1000 miles, and 2 models of direction finders and accessory units. Includes features, operation, construction, and specifications.—Applied Electronics Co., Inc., 1240F Folsom St., San Francisco 3, Calif.

U-1266 **Telemetering.** New 4-page issue Vol. 4 No. 2 of "The Autocon Rambler" defines telemetering, outlines some typical applications, and enlarges on systems for water and sewage applications.—Automatic Control Co., 1005 University Ave., St. Paul 4, Minn.

U-1267 **Receivers, Transmitters.** Two new bulletins describe maker's "Model CR-9" dual conversion receivers and "Model MT-25W" 25-watt mobile transmitter. Includes construction, operation, and features.—Sylvan Electronics Laboratories, Inc., 393 N. Pearl St., Albany, N. Y.

U-1268 **Microwave Waveguides.** New 12-page Form 852.15 illustrates and describes maker's line of microwave components. Includes specifications for rigid and flexible waveguides, also schematic diagrams and application charts.—Titeflex, Inc., 500 Frelinghuysen Ave., Newark 5, N. J.

U-1269 **Volume Limiters.** New 8-page issue Vol. 1. No. 8 of "The Lenkurt Demodulator" explains essential difference between limiters in carrier systems and other volume-range controllers. Also article on carrier terminal and repeaters.—Lenkurt Electric Co., San Carlos, Calif.

U-1270 **TV Schematics.** New 80-page Service Directory SP-1014 (10⅞ x 16¾) contains schematic diagrams and parts lists for all 71 models of 1950 and 1951 RCA TV receivers. Price $1.50.—Radio Corp. of America, Harrison, N. J.

U-1271 **TV-IF Interference.** New 12-page illustrated issue Vol. 19, No. 8 of "Sylvania News" includes articles on TV-IF interference and on operating many TV-FM receivers from one antenna.—Sylvania Electric Products, Inc., 110 Main St., Buffalo 9, N. Y.

## Magnetic

U-1272 **Magnetic Comparators.** New 12-page bulletin describes and illustrates maker's comparators for high-speed separation of materials. Includes features, applications, advantages, production types, and history. Lists users. —Magnetic Analysis Corp., 42 12th St., Long Island City 1, N. Y.

U-1273 **Magnetic Indicator.** New 4-page bulletin illustrates and describes maker's indicator for testing electric motors, solenoids, or magnetic fields. Includes operation, instructions, and descriptions of 5 types of probes.—H-B Indicator Co., 915B Terminal Sales Bldg., Seattle 1, Wash.

U-1274 **Instrument Current Transformers.** New Bulletin 3AA illustrates and describes maker's new 2¼-inch large-window "Donut" transformers for use with ammeters, relays, and wattmeters.—Associated Research, Inc., 3766 W. Belmont Ave., Chicago 18, Ill.

U-1275 **Shielded Rooms.** New Engineering Bulletin 3 illustrates and describes maker's cell-type screen rooms for r-f. noise suppression. Includes construction and specifications.—Ace Engineering & Machine Co., Inc., 3644 Lawrence St., Phila. 40, Penna.

## Voltage Stabilizers

U-1276 **Automatic Voltage Stabilizers.** New 12-page Bulletin GEA-5754 illustrates and describes maker's automatic voltage stabilizers ranging from 15 to 15,000 volt amperes. Includes operation, principles, construction, specifications, and applications.—General Electric Co., Schenectady 5, N. Y.

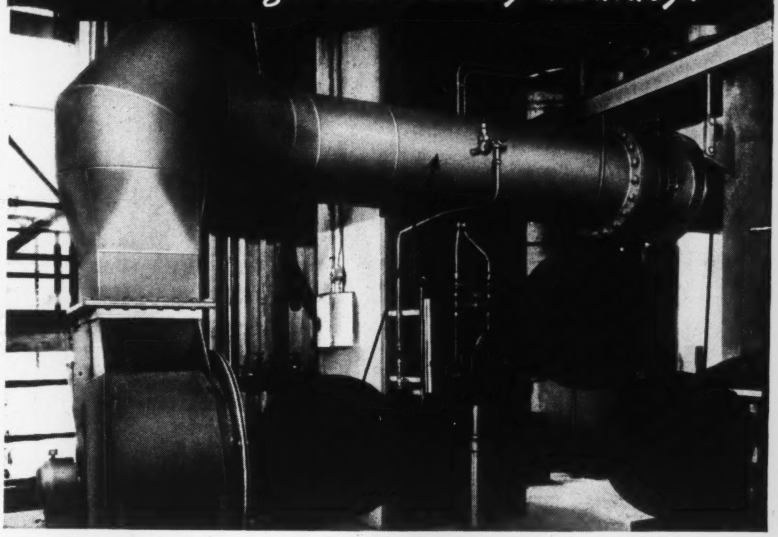
## Electronic Test Equipment

U-1277 **Electronic Test Equipment.** New 4-page catalog illustrates and describes complete line of Hickok test equipment handled by distributor. Includes features and descriptions of oscilloscopes, signal generators, tube testers, multimeters, VTVM's, marker-calibrators, probes, and accessories.—Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.

U-1278 **Test Equipment.** New 4-page issue Vol. 8 No. 3 of "Allied News" features descriptions of electronic test equipment. Also "Pamco" product-life tester that turns circuit on and off while counting operations. Also described are 3-dimensional TV camera for surgery and other new developments.—Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.

U-1279 **Electronic Test Equipment.** New 14-page October issue of "The Flyer" illustrates and describes maker's kits for oscilloscopes, voltage calibrators, voltmeters, signal generators, and other electronic test equipment.—The Heath Co., Benton Harbor, Mich.

U-1280 **Signal Generator.** New 4-page Vol. 4 No. 1-2 issue of "hp Jour-



[illegible] can put a flow tube in [illegible]
[illegible] if it's [illegible]

*...and still get satisfactory accuracy!*

The Flow Tube needs only minimum straight runs entering and following the tube, and the Flow Tube itself takes up so little space that it can be installed at practically any accessible point where flow conditions are reasonably steady. This means considerable savings in space and equipment to provide straight entering runs required by conventional head meters.

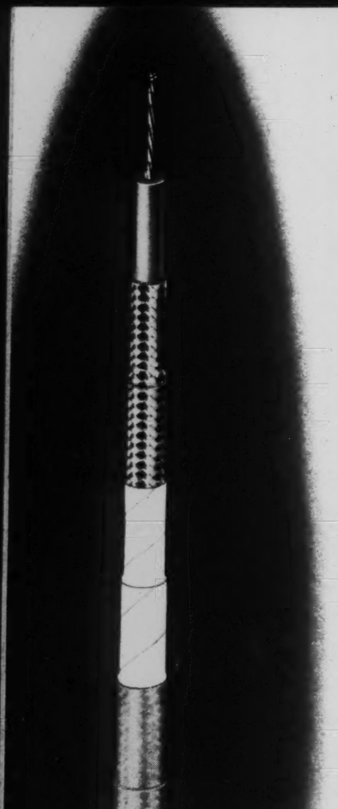
The installation shown above in a catalytic cracking unit of a Southwestern oil refinery is a typical example. Here a 30″ Flow Tube with a 23.9″ throat (D/d = 1.26) is measuring the air used to reactivate the catalyst. It delivers a differential of 10″ of water for a maximum flow of 39,000 standard cfm at 137°F. and 3.5 psig. The unrecovered head loss in this Tube at maximum flow is 1″ of water. Two other tubes are also operating under similar conditions in this refinery.

All are performing satisfactorily as installed. Periodic checks all show that they are measuring within plus or minus 2% of the blower manufacturer's characteristic curve.

Flow Tubes are manufactured exclusively by Foster Engineering Co. in all pipe sizes for measuring the flow of liquids and wet or dry gases. Flow Tubes can be furnished with or without suitable secondary indicating, recording, or totalizing instruments. For further information, ask for Bulletin FT-101; and for specific recommendations, please send us necessary flow data.

**FOSTER ENGINEERING**

*SEE US AT THE POWER SHOW • NEW YORK • DECEMBER 1-6 • BOOTHS 38-39*



high heat resistance... low loss...

Designed for extreme heat conditions, such as are encountered in modern aircraft, Teflon dielectric performs satisfactorily in temperatures as high as 500° F. Use of Teflon as dielectric in RF cables is an outstanding achievment of the skilled research team at Amphenol.

In addition to the important feature of high heat resistance, Teflon has electrical characteristics which exceed those of Polyethylene. Teflon is the *one* satisfactory cable for use, not only in aircraft, jet engines or guided missiles, but in covered electronic equipment or any application where temperatures might run over 185° F.

**TEFLON**

**POLYTETRAFLUOROETHYLENE**

for insulation in cables & connectors

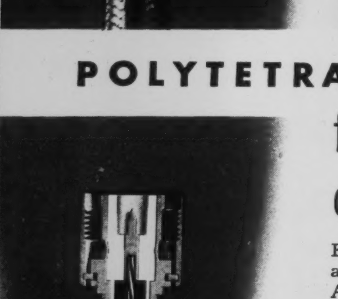
Expert engineering, highest quality materials and stringent continuous inspection make Amphenol cables the very best that can be had *anywhere!* Uniform quality and maximum performance from every foot of Amphenol cable is assured by constant checking and testing. Every shipment of cable is accompanied by a notarized affidavit certifying the guaranteed construction of the cable.

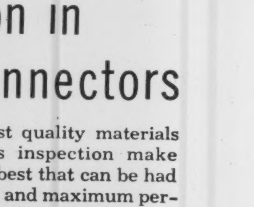
Amphenol also manufactures a comprehensive line of RF Connectors with Teflon inserts for high voltage or extreme heat applications.

*Write for this free literature describing Amphenol Teflon cable. Address Dept. 13D*

**AMERICAN PHENOLIC CORPORATION**
1830 SOUTH 54TH AVENUE • CHICAGO 50, ILLINOIS

AMPHENOL





nal" features article on flexibility of new "Model 318B" 3800-7600 Mc. signal generator; also article on measuring large resistances.—Hewlett-Packard Co., 395 Page Mill Rd., Palo Alto, Calif.

U-1281 **Frequency Standards.** 38-page brochure illustrates and describes maker's bi-metallic fork-controlled oscillators, aluminum-alloy tuning-fork set and other fork-controlled frequency-standard instruments and accessories. —Riverbank Laboratories, Geneva, Ill.

U-1282 **Voltage Tester.** New bulletin illustrates and describes maker's "Hi-Test" voltage tester for a-c. lines. Includes information on maker's "Hi-Neon" test lite.—Holub Industries, Inc., Sycamore, Ill.

U-1283 **High-current Test Unit.** New descriptive Bulletin 1005-111 illustrates maker's portable high-current test unit (up to 1000 amperes) for testing current transformers, relays, circuit breakers, etc. Includes uses and construction.—Multi-Amp Corp., Harrison, N. J.

## Electrical & Electronic Components

U-1284 **Electronic Components.** New 4-page issue Vol. 5 No. 7 of "Amphenol Engineering News" illustrates and describes use of "Amphenol" multi-contact connectors in jet planes, position servo systems, communication units, and other equipment for industrial and scientific use.—American Phenolic Corp., 1830 South 54th Ave., Chicago 50, Ill.

U-1285 **Resistors.** New 2-page Engineering Bulletin L-27 discusses differences between new MIL-R-93A and old JAN-R-93 specifications. Cross-reference table gives maker's resistors designed in accordance with specs.—Shallcross Mfg. Co., Collingdale, Pa.

U-1286 **Resistors, Switches.** 2-page Sept. issue of "The Ohmite News" features article on use of maker's resistors and switches in Westinghouse surge comparison testers. Other articles on heat-control rheostats, resistance boxes, etc.—Ohmite Mfg. Co., 4835 Flournoy St., Chicago 44, Ill.

U-1287 **Mica-dielectric Capacitors.** New 32-page Catalog 31 illustrates and describes maker's transmitter-type fixed mica-dielectric capacitors built to Jan-C-5 specs. Includes characteristics, features, and applications.—Sprague Electric Co., North Adams, Mass.

U-1288 **Capacitors.** New 6-page reprint gives history of company and illustrates modern methods now employed in production of capacitors, resistors, printed circuits, magnet wire, radio interference filters, and pulse-forming networks.—Sprague Electric Co., North Adams, Mass.

U-1289 **Potentiometer Noise.** New 12-page brochure diagrams and describes source and nature of six major types of electrical noise found in potentiometer-rheostats. Assigns unit of measurement to electrical noise and shows how to isolate and measure each source.—The Helipot Corp., S. Pasadena, Calif.

U-1290 **Precision Pots.** New 6-page Brochure 10952 illustrates and de-

**See pages 1766-1767 for classified list of advertised products**

scribes maker's precision potentiometer-rheostats. Gives construction, applications, specifications, and features.—The Servotrol Co., 114 W. Illinois St., Chicago 10, Ill.

U-1291 **Motor-operated R-f. Switch.** New 2-page brochure illustrates and describes new "Model CA-31 Sensing Switch" with actuating motor for time sharing two r-f. circuits with frequencies to 250 Mc.—Thompson Products, Inc., 2196 Clarkwood Rd., Cleveland 3, Ohio.

U-1292 **Switches, Jacks.** New 16-page brochure illustrates and describes maker's multiple-circuit lever switches, turn and push switches, and plug jacks. Includes applications, construction, and contact ratings.—Donald P. Mossman, Inc., 84 W. Jefferson St., Joliet, Ill.

U-1293 **Coaxial Accessories.** New 12-page issue Vol. 27 No. 5 of "The General Radio Experimenter" illustrates and describes maker's new coaxial accessories: adaptors, line stretcher, component mount, balun, terminations and insertion unit. Includes features, principles of operation, and specifications.—General Radio Co., 285 Massachusetts Ave., Cambridge 39, Mass.

U-1294 **Transformers.** New 24-page brochure illustrates and describes maker's complete "UTC" line of transformers, reactors, filters, and magnetic amplifiers. Includes features, applications, and parts lists.—United Transformer Co., 150 Varick St., New York 13, N. Y.

U-1295 **Transformers.** New 16-page catalog lists replacement information on over 4400 TV models and chassis. Also section listing 117 of maker's replacement transformers with electrical and physical specifications.—Standard Transformer Corp., 3580 Elston Ave., Chicago 18, Ill.

U-1296 **Thyratron.** New 8-page Bulletin 6012 illustrates and describes maker's "6012" negative-control gas thyratron for use in relay and grid-controlled rectifier applications. Includes application and characteristics.—RCA Tube Dept., Harrison, N. J.

**A supply of these cards for the asking**

Is your copy of *Instruments* routed to several people?

Does your Company Librarian forbid mutilating tech mags?

Or do you yourself wish to preserve your own copies intact?

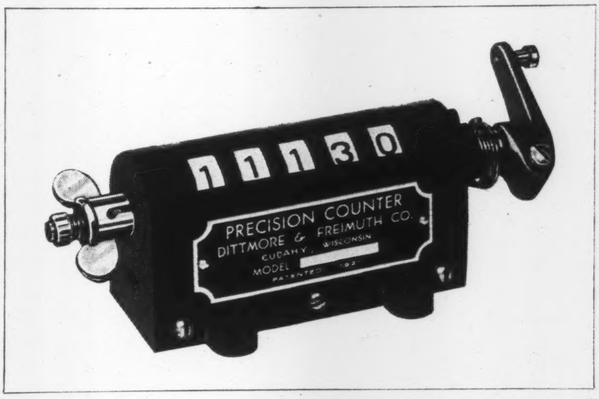
*Just drop us a postal card asking for Inquiry Cards and we'll send you twelve! Do it NOW.*

U-1297 **Relays.** New 12-page Circular 1702-A illustrates and describes maker's complete line of telephone-type relays, including hermetically sealed, plug-in, and subminiature types. Includes applications and specifications.—Automatic Electric Co., 1033 W. Van Buren St., Chicago 7, Ill.

*NEW* **PRECISION COUNTERS**

**OFFER MANY EXCLUSIVE ADVANTAGES**

***PLUS* LOW COST!**



IDEAL FOR Punch Presses, Screw Machines, Printing Presses, Drill Presses, Die Casting Machines, Production Lathes, Pumps, Coil Winders, Conveyors, Etc.

**PRECISION COUNTERS ASSURE** ***Accuracy • Durability • Visibility • Low Maintenance Costs***

***Counters for Special Applications Designed and Manufactured***

**WRITE NOW FOR DETAILED SPECIFICATIONS**

**DITTMORE & FREIMUTH CO.**
**2517 E. Norwich Ave., Cudahy, Wis.**

*Instruments*, 921 Ridge Ave., Pittsburgh, Pa. *(December 1952)*
*Not good after Feb. 1, 1953*

**Please have the following pieces of LITERATURE sent to me:**

***Numbers*** ______________________

**I desire further information on the following NEW INSTRUMENTS:**

***Numbers*** ______________________

**I desire details on the following ADVERTISED PRODUCTS (Write page number and name of company or product number (see page 1766)**

**Name** ______________ ***Title*** ______________
**Please Print**

**Company** ______________________

**Co.'s Address** ______________________

# ADVERTISERS' INDEX

Acragage Co. .... 1698
Acromark Company .... 1706
Aluminum Company of America .... 1750
American Chain & Cable Co. .... 1769
American Instrument Co., Inc. .... 1765
American Machine & Metals, Inc. .... 1661, 1665
American Phenolic Corp. .... 1774
American Time Products, Inc. .... 1648
Amthor Testing Instrument Co. .... 1704
Annin Company .... 1640
Arnold Engineering Co. .... 1672
Atlas Valve Company .... 1686
Automatic Electric Mfg. Co. .... 1697
Automatic Switch Co. .... 1764

Bailey Meter Co. .... 1658
Bendix Aviation Corp. .... 1707
Berkeley Scientific Div., Beckman Instruments, Inc. .... 1687
Bethlehem Apparatus Co., Inc. .... 1749
Borg Corp., George W. .... 1710, 1711
Bourns Laboratories .... 1771
Bowser, Inc. .... 1634
Bristol Co. .... 1646, 1673
Brown Electro-Measurement Corp. .... 1708
Brush Development Co. .... 1713
Burlington Instrument Co. .... 1704

Cambridge Instrument Co., Inc. .... 1751
Cannon Electric Co. .... 1683
Carboloy Dept. of General Electric Co. 1642-1643
Century Geophysical Corp. .... 1685
Chace Co., W. M. .... 1695
Collins Microflat Co. .... 1710
Colvin Laboratories .... 1749

Daven Co. .... 1700
Dial Light Co. of America .... 1752
Dittmore & Freimuth Co. .... 1775
Dragon Engineering Company .... 1688
DuMont Labs., Inc., Allen B. .... 1654

Electric Auto-lite Co. .... 1746
Electronic Associates Inc. .... 1659
Emery Co., A. H. .... 1689
Eppley Laboratory, Inc. .... 1749

Fairchild Camera & Instrument Corp. .... 1671
Falstrom Company .... 1632
Farris Engineering Corp. .... 1691
Farris Flexible Valve Corp. .... 1693
Federated Semi-Conductor Co. .... 1681
Fischer & Porter Co. .... 1655
Fisher Governor Co. .... Inside Front Cover-1629
Foster Engineering Company .... 1773
Foxboro Company .... 1700, 1763
Friez Instrument Div., Bendix .... 1707

Gaertner Scientific Corp. .... 1699
General Electric Company .... 1653, 1751
Giannini & Co., Inc., G. M. .... 1647
G-M Laboratories, Inc. .... 1696
Gordon Co., Claud S. .... 1690
Gotham Instruments, Div. of American Machine & Metals, Inc. .... 1661
Gow-Mac Instrument Co. .... 1755
Green Instrument Co. .... 1760

Hagan Corporation .... 1652, 1669
Hammel-Dahl Co. .... Back Cover
Hays Corporation .... 1724
Heise Bourdon Tube Co. .... 1709
Helicoid Gage Div. .... 1769
Helipot Corp. .... 1755
Hewlett-Packard Company .... 1641
Hexacon Electric Co. .... 1701

Illinois Testing Laboratories, Inc. .... 1762
Industrial Div., Minneapolis-Honeywell Regulator Co. .... 1635, 1656, 1702-1703, 1741
Industrol Corp. .... 1679
Instrument & Control Consultants .... 1776
Instruments Publishing Co. .... 1747
International Rectifier Corporation .... 1637

Johnson Engineering Co., Inc., Welton V. .... 1712

Kemp Mfg. Co., C. M. .... 1767
Kieley & Mueller, Inc. .... 1630-1631

Lambda Electronics Corporation .... 1698
Leeds & Northrup Co. .... 1674, 1742
Leslie Co. .... 1676
Levin & Son, Inc. Louis .... 1751
Lewis Engineering Co. .... 1633

Macbeth Instrument Corp. .... 1760
Machinery Lloyd .... 1754
Manning, Maxwell & Moore, Inc. .... 1670
Marsh Instrument Co. .... 1762
Marshalltown Mfg. Co. .... 1767
Measurements Corp. .... 1706
Mercoid Corporation .... 1698
Meriam Instrument Co. .... 1753
Mico Instrument Co. .... 1698
Midwestern Geophysical Laboratory .... 1759
Milton Roy Company .... 1645
Minneapolis-Honeywell Regulator Co. .... 1635, 1656, 1692, 1702-1703, 1741
Moeller Instrument Co. .... 1761
Monsell, John R. .... 1707
Murphy & Miller, Inc. .... 1758

Nash Engineering Company .... 1664
New Hermes, Inc. .... 1704
North American Aviation, Inc. .... 1678

Palmer Thermometers, Inc. .... 1755
Panellit, Inc. .... Inside Back Cover
Parker Appliance Company .... 1638, 1639
Pittsburgh Lectrodryer Corporation .... 1660
Potter Aeronautical Co. .... 1662

Rochester Mfg. Co., Inc. .... 1705
Rockwell Co., W. S. .... 1746

Sanborn Co. .... 1639
Schutte & Koerting Co. .... 1649
Servo Corporation of America .... 1709
Shore Instrument & Mfg. Co. .... 1708
Statham Laboratories .... 1694
Steinen Mfg. Co., Wm. .... 1684
Sturtevant Co., P. A. .... 1706
Sun Electric Corporation .... 1748
Superior Tube Company .... 1657
Swartwout Company .... 1757

Taylor Instrument Companies .... 1650-1651
Telechron Department, General Electric Company .... 1758
Trimount Instrument Company .... 1765
Trinity Equipment Corp. .... 1705
Triplett Electrical Instrument Co. .... 1663

Uehling Instrument Co. .... 1699
Unertl Optical Co., John .... 1708
United States Gauge, Div. of American Machine & Metals, Inc. .... 1665
United States Radium Corp. .... 1772

Vapor Recovery Systems Company .... 1682
Veeder-Root Inc. .... 1666
Victory Engineering Corporation .... 1712

Wallace & Tiernan Products, Inc. .... 1667
Waterman Products Co., Inc. .... 1680
Webber Appliance Co., Inc. .... 1696
Weksler Thermometer Corporation .... 1765
Weston Electrical Instrument Corp. .... 1636, 1668
Wheatstone Corporation .... 1710
Wheelco Instruments Division, Barber-Colman Company .... 1644
White Dental Mfg. Co., S. S. .... 1711

## INSTRUMENT & CONTROL CONSULTANTS

Engineering Services, Testing Laboratories and other Professional Services

**ENGINEERING DIVISION**
**M. S. JACOBS & ASSOCIATES, INC.**
APPLICATION & ENGINEERING OF INDUSTRIAL PROCESS CONTROLS SPECIALIZING IN THE STEEL & CHEMICAL INDUSTRIES.
810 NOBLESTOWN ROAD • CARNEGIE, PA.
TELEPHONE (Pittsburgh, Pa.) Walnut 1-6140

**FLUID CONTROLS CO., INC.**
*Control Engineers*
Procurement, Application, Design and Installation Supervision of control systems in Refining, Chemical, Aircraft, Paper, Power and associated industries.
NEW YORK PHILADELPHIA BALTIMORE
(28)

Your card as per above in 12 issues of INSTRUMENTS for $100, payable in advance.

FIRST CLASS
PERMIT No. 1441
(Sec. 34.9 P. L. & R.)
PITTSBURGH, PA.

**BUSINESS REPLY CARD**
NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

4c-POSTAGE WILL BE PAID BY—

INSTRUMENTS PUBLISHING CO.
921 Ridge Avenue
Pittsburgh 12, Pa.

# THE 1952 Instruments Index

PART TWO OF THE
OCTOBER 1951 ISSUE
of Instruments
THE MAGAZINE OF
Measurement
and Control

Instruments Publishing Company, Pittsburgh 12, Penna.

Can we Win a "Push-button" Peace?

CAN WE have our cake, butter, and guns too? Shooting war or cold war, we know that we'll have to keep on producing billions of dollars worth of defense goods annually. Can we do it, and at the same time check inflation by making enough to fill civilian demands?

One thing is certain . . . when we do reach our goal, "push-button" control will have played a very important part. United States industry has increased production about 20% every ten years since 1850 largely as a result of the increasing use of tools and instruments. Today there are more people employed in making instruments and tools alone than there were in all of manufacturing a century ago. Take the case of one cycling and natural gasoline plant. Twenty years ago it would have needed twenty men on a shift, with about 75 instruments. Today it operates with only ten men on a shift, using over 300 instruments.

There is hardly an industrial process—batch or continuous—that can't be run better and more economically with modern instrumentation. You can duplicate your best results time after time, reducing rejects and waste of precious raw materials, and making more efficient use of increasingly scarce skilled manpower.

What's more, you can get a permanent record of every phase of a process, isolating departmental processing and heating costs for more accurate cost accounting and detecting faulty operation of equipment.

If you aren't familiar with Taylor's new developments in automatic control, now is the time to look into them. Taylor's new TRANSET* System makes possible much closer control than anyone would have dreamed possible a short time ago . . . and new Taylor Instruments are now bringing amazingly high efficiency to almost every industry. Use Taylor Controls on all of your processes . . . the results will speak for themselves. Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada.

*Trade-Mark

▾ ▾ ▾

*Instruments for indicating, recording and controlling temperature, pressure, humidity, flow, liquid level, load, speed and density.*

TAYLOR INSTRUMENTS MEAN ACCURACY FIRST

## *For the Measurement of*
## SOLAR RADIATION

Eppley Pyrheliometers are used for solar radiation measurements at ninety-eight weather stations in the continental United States, Canada, Alaska, Greenland, Iceland, Caribbean Sea, and the Pacific Ocean. Sixty-two of these stations are under the direction of the United States Weather Bureau. The Eppley Pyrheliometer was adopted as standard equipment by the Weather Bureau after considerable experimentation. It was found to be the best instrument so far tested by the Bureau.

Used in conjunction with a suitable recorder, the Eppley Pyrheliometer will provide an accurate and reliable record of total solar and sky radiation on a horizontal surface.

*Bulletin No. 2 On Request*

**THE EPPLEY LABORATORY, INC.**

**NEWPORT — RHODE ISLAND — U. S. A.**

# VOLTAGE REGULATED POWER SUPPLIES

## *For Industrial and Research Use*

**MODEL 510**

Model 510 features TWO COMPLETELY INDEPENDENT REGULATED POWER SUPPLIES.

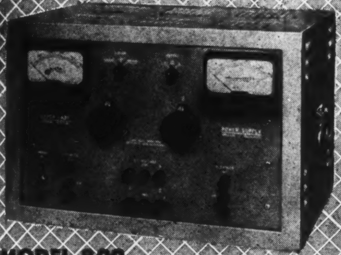
**OUTPUT DC FOR EACH SUPPLY:** 200-500 volts, 200 Ma.

**REGULATION:** ½% for both line and load variations.

**RIPPLE:** 5 millivolts.

**OUTPUT AC FOR EACH SUPPLY:** 6.3 volts, 6 Amp., CT.

The supplies may be connected for series, parallel, or bucking operation.



**MODEL 800**

Model 800 features TWO INDEPENDENT REGULATED POWER SUPPLIES.

**OUTPUT DC FOR EACH SUPPLY:** 0-600 volts, 200 Ma. in parallel 400 Ma.

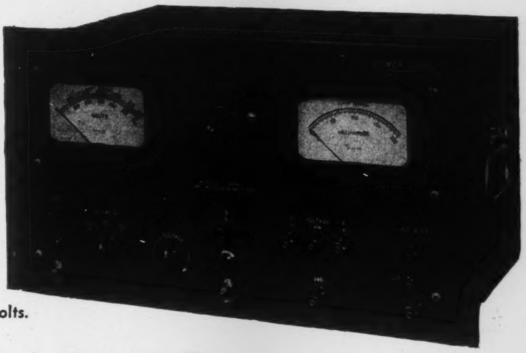
**REGULATION:** ½% for both line and load variations.

**RIPPLE:** 5 millivolts.

**OUTPUT AC FOR EACH SUPPLY:** 6.3 volts, 10 Amp., CT.

**REGULATION 0.1%**

KEPCO LABORATORIES manufactures on special order high quality, extremely well regulated Power Supplies. Let us quote on your special requirements.



**MODEL 815**

**B SUPPLY:** 0-600 volts, 200 Ma.

**REGULATION:** ½% for both line and load variations.

**RIPPLE:** 5 millivolts.

**C SUPPLY:** 0-150 volts, 5 Ma.

**REGULATION:** 10 millivolts for line 105-125 volts. ½% for load at 150 volts.

**RIPPLE:** 5 millivolts.

**FILAMENT SUPPLY:** 6.3 volts AC, 10 Amp., CT

**MODEL 315**

**B SUPPLY:** 0-300 volts, 150 Ma.

**REGULATION:** ½% for both line and load variations.

**RIPPLE:** 5 millivolts.

**C SUPPLY:** 0-150 volts, 5 Ma.

**REGULATION:** 10 millivolts for line 105-125 volts. ½% for load at 150 volts.

**RIPPLE:** 5 millivolts.

**FILAMENT SUPPLY:** 6.3 volts AC, 5 Amp., CT.

Available with Rack Mounting

**MODEL 500-R**

**OUTPUT DC:** 0-500 volts, 300 Ma.

**REGULATION:** ½% for both line and load variations.

**RIPPLE:** 10 millivolts.

**OUTPUT AC:** 6.3 volts, 10 Amp., CT.

Model 615 is the Model 500-R plus C supply

**MODEL 245**

**OUTPUT DC:** 200-500 volts, 200 Ma.

**REGULATION:** ½% for both line and load variations.

**RIPPLE VOLTAGE:** 5 millivolts.

**OUTPUT AC:** 6.3 volts, 6 Amp., CT.

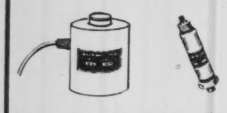
Available with Rack Mounting

*MANUFACTURERS OF ELECTRONIC EQUIPMENT • RESEARCH • DEVELOPMENT*

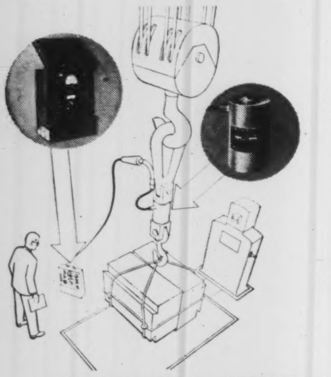
# KEPCO
## LABORATORIES, INC.

149-14 41st AVENUE • FLUSHING, N. Y.

**FOR SPECIFICATIONS ON OUR COMPLETE LINE OF POWER SUPPLIES-WRITE DEPT. Y**



# BALDWIN SR-4® DEVICES are solving all these problems . . . How About Yours?

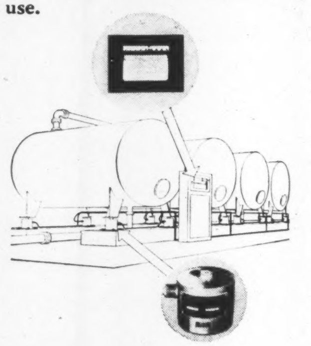


## WEIGHT CALIBRATION OF LARGE PLATFORM SCALES

Mounting an SR-4 Load Cell in a crane hook permits continuing checks of platform scales to be made with minimum time and effort. Instead of shifting check-weights about the plant, any suitable bulky crane cargo can be utilized, by reading its weight on the electronic portable indicator, then comparing it with the weight registered by the platform scales.

Other applications include the use of the SR-4 Crane Hook Mounted Unit for batch weighing . . . for a limit alarm to avoid crane overloading . . . and for the weighing of truck or rail shipments.

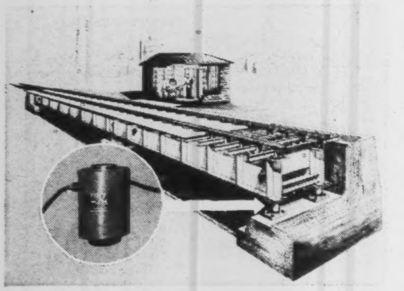
Baldwin SR-4 Load Cells have no moving parts, and are simple, rugged and durable. Accuracy is maintained over long periods of active use.



## MULTI-TANK WEIGHING AND BATCH CONTROL OF LIQUIDS

Baldwin SR-4 Load Cells bring new simplicity, sensitivity and reliability to measuring and batching liquids by weight. Cells may be located under any existing framework or supports, require small headroom, and record with no appreciable movement of the sensing element. As units are completely sealed, cleaning is simplified, and any interference with accuracy because of corrosion or deposits is eliminated.

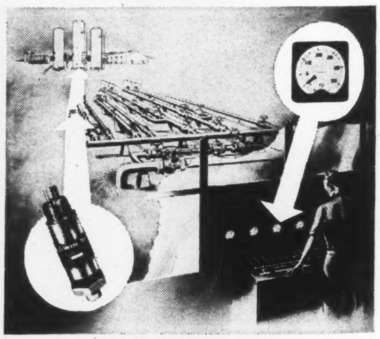
The indicating, recording or control instrument may be located at any convenient point, and used to report the weight of material in any number of tanks or hoppers. Savings in pitting and through the elimination of multiple parts bring cuts in cost.



## TRACK SCALE FOR "DORMANT" AND "MOTION" CAR WEIGHING

Savings in first cost, a decrease in pit depth, reduced maintenance, and continuing accuracy are all among the advantages already recorded for track scales using SR-4 devices. Total vertical motion required for full load weighing is a matter of thousandths of an inch, permitting more rugged construction and lessening the effects of shocks during use.

These advantages take on added importance in the "motion" weighing scales used in car humping, where the absence of swing and "bounce" in the weigh bridge, plus almost instantaneous damping in the indicator, permits faster, more accurate readings.



## REMOTE PRESSURE MEASUREMENT IN OIL AND CHEMICAL PLANTS

Baldwin SR-4 Pressure Cells provide an accurate, economical means of measuring, controlling or monitoring fluids and gases. Cells may be placed at any desired location, and through electrical connections will "report-in" continuously to a remote central point. Another important application is in research, as the cells provide an unusually accurate means of measuring ultra-high pressures, surges, and explosion waves. Hysteresis and inertia effects are virtually abolished.

Tube material can be varied to meet a wide variety of pressure and corrosion conditions. Standard capacities are 200; 500; 1,000; 2,000; 5,000; 10,000; 20,000 and 50,000 psi.

A low-range series, with standard capacities of 10; 20; 50 and 100 psi, is also available.

Your own ingenuity will probably suggest many places where Baldwin SR-4 Load Cells and Pressure Cells can be used, cutting your manufacturing or processing costs. One of our representatives will be glad to give you full details on sizes and types available.

**BALDWIN-LIMA-HAMILTON CORPORATION**
**Eddystone Division • Philadelphia 42, Pa.**
**Offices:** CLEVELAND, CHICAGO, HOUSTON, LOS ANGELES, NEW YORK, NORFOLK, SAN FRANCISCO, WASHINGTON.
**IN CANADA: PEACOCK BROS., LTD., MONTREAL, QUEBEC**

BALDWIN LIMA-HAMILTON BLH

# BALDWIN-LIMA-HAMILTON

## TESTING HEADQUARTERS

# Coordinated

## INSTRUMENTATION AND CONTROL by HAGAN

The satisfactory functioning of a system of instrumentation and automatic control requires that the characteristics of each unit of equipment shall be correct for its particular service and that these characteristics shall be coordinated with those of all other related units.

The coordinated equipment developed by Hagan engineers includes pressure measuring and control devices for any range from a few thousandths of an inch water column to 5,000 psig; force measuring devices which will respond to the weight of a dime — or measure the total thrust of a jet bomber; panel type relay units which provide for modification of loadings and for remote manual control; double acting power units in sizes which provide precision control of tiny valves or of heavy slide dampers.

With such a variety of equipment, Hagan engineers can design the system which best meets the requirements of each individual application.

Certain types of installations, for example, are best served by mechanical metering units, with feeler lines connected direct to a self-contained recorder. The Hagan Ring Balance Flow Meter is designed particularly for this type of service.

Standard assemblies are made to measure flow differentials from ½ inch up to 420 inches WC, at static pressures as high as 15,000 psig.

These units may indicate, record and integrate one or two rates of flow. Addition, subtraction and compensation for temperature and pressure conditions may be included. Integration is maintained with high accuracy, even at the lowest flow rates.

Other types of installations may require that measuring elements be located near the primary device, sending pneumatic signals to recorders, as well as to control circuits. For this service, the Ring Balance Transmitter may be used at static pressures up to 15,000 psig and measuring maximum differentials as high as 420 inches WC.

Other types of units for translating pressure differentials into pneumatic signals are designed to serve as line type liquid meters or as differential measuring units in various ranges to a maximum pressure differential of 100 psi at static pressures up to 1,500 psig.

In all except the very simplest control systems, there is specific need for control mechanisms which can combine control signals. Some involve addition or subtraction of signals, while others involve multiplication, division, or even more complicated functions. The Hagan Ratio Totalizer is designed for almost universal application for accurately combining input control pressures and spring forces to produce a single pneumatic output control signal.

The Hagan THRUSTORQ, for translating mechanical forces into pneumatic signals for instrument or control circuits, fulfills the exacting requirements of aeronautical and similar testing laboratories.

Other Hagan Automatic Control units are designed for measurement and control of pressure, draft, temperature, engine or turbine speed, fuel-air ratio, damper or valve positioning, and the many other functions which may enter into the final solution of a particular problem.

A letter or a telephone call to the nearest office will enlist at once the coordinated facilities of our engineers in solving *your* problem.

## HAGAN CORPORATION

**Hagan Building, Pittsburgh 30, Pa.**

**Baton Rouge, La. • Birmingham, Ala. • Boston, Mass. • Buffalo, N. Y. • Charlotte, N. C. • Chicago, Ill.**
**Cincinnati, O. • Cleveland, O. • Denver, Colo. • Detroit, Mich. • Huntington, W. Va. • Kansas City, Mo.**
**Los Angeles, Calif. • New York, N. Y. • Philadelphia, Pa. • Portland, Ore. • St. Louis, Mo. • St. Paul, Minn.**
**San Francisco, Calif. • Schenectady, N. Y. • Seattle, Wash. • Toledo, O. • Warren, Pa. • Washington, D. C.**
**IN CANADA—Toronto, Ont. • Montreal, P. Q. • Vancouver, B. C.**

Let
BURGESS
Solve Your
Battery
Problems!
Complete Engineering
Facilities at Your
Disposal
BURGESS
4FH
LITTLE SIX
BURGESS
5308
BURGESS

Burgess engineers have devoted more than 30 years to special battery development and manufacture. Now, *you* can profit by it! The complete Burgess facility . . . engineering . . . design . . . production . . . is available to provide you with the exact dry battery for your particular application!

**Enter Your Requirements with Us!**

If you are in the design stage and need a special battery to meet your requirements, mail the coupon below for a FREE check-sheet to enter your battery specifications with Burgess engineers. They will then send you complete information on your special battery.

**Hundreds of Battery Types Already Available**

**You may find the exact battery for your special requirements among the hundreds of types already developed by Burgess engineers. Standard and special types are handled by Burgess distributors everywhere, thus simplifying replacement battery problems for users of your equipment.**

***MAIL COUPON TODAY!***

**Burgess Battery Company**
**Dept. II-10, Freeport, Ill.**

Please send, without cost or obligation, a Burgess check-sheet for entering our dry battery specifications.

*Name*.......................................*Title*...........
*Firm Name*..................................................
*Address*.....................................................
*City*...................*Zone*.......*State*........

# THE 1952 INSTRUMENTS INDEX

## CONTENTS

**1. *Index to Instruments and Apparatus.* In this section, products are listed alphabetically. Under each heading appear the names of the manufacturers of this equipment (and of the sole representatives of such manufacturers). *Pages 42 to 155.***

**2. *List of the Laboratory Supply Houses.* Under the heading "Apparatus, Laboratory," on page 46, are listed companies specializing in laboratory supplies, equipment, instruments and apparatus.**

**3. *Directory of Manufacturers and sole representatives*, with complete addresses and brief descriptions. *Pages 157 to 179.***

## ADVERTISERS' INDEX

Acragage Company ............ 73
Acromark Company ............ 155
Advance Electric & Relay Co.. 115
Aeromarine Instrument Co., Inc... 76
All American Tool & Manufacturing Co. .......... 131
American Chain & Cable Co. .. 75
American Machine and Metals, Inc. ........................29, 41
American Meter Co. .......... 19
American Paulin System ....... 48
American Thermo-Electric Co. . 134
American Time Products, Inc. .. 36
Amglo Corporation ............ 38
Amthor Testing Instrument Co.. 132
Applied Research Laboratories . 123
Askania Regulator Co. ........ 115
Associated Research, Inc. ...... 127
Atkomatic Valve Company, Inc.. 140
Atomic Instrument Company ... 64
Automatic Electric Sales Corporation .................. 125

Bailey Meter Co. ............ .....49, 55, 56, 60, 63, 76, 91, 109
Baird Associates Inc. ......... 122
Baldwin-Lima-Hamilton Corp. . 2
Ballantine Laboratories, Inc. .. 153
Barber Laboratories, Alfred W. 155
Barksdale Valves .............. 125
Barton Instrument Corp. ........ 71
Beacon Gage Company ......... 78
Beckman, Inc., Arnold O. ...... 81
Bendix Aviation Corp., Eclipse-Pioneer Div. ......97, 113
Bendix Aviation Corp., Pacific Div. .................. 118
Berkeley Scientific Corporation.. 67
Biddle Co., James G. ......... 129
Bird & Co., Inc., Richard H. . 49
Black, Sivalls & Bryson, Inc... ......................9, 10, 11, 12
Bogue Electric Manufacturing Company ...................... 37
Boonton Radio Corporation ..... 111
Booth Company, Arthur E. ..... 107
Branson Instruments, Inc. ...... 131
Bristol Co. ...................... ... 77, 85, 109, 110, 118, 137, 158
Brush Development Co. ........ 5
Buffalo Meter Co. ............ 91
Burgess Battery Company ...... 4
Burke & James, Inc. ......... 101
Burling Instrument Co. ....... 28

Cannon Electric Co. .......... 55
Central Scientific Company ..... 85
Century Geophysical Corp. ....14, 15
Chatillon & Sons, John ........ 180
Chelsea Clock Co. ............ 161
Cinema Engineering Company .. 46
Clarkstan Corp. ............... 90
Cohn Corp., Sigmund ......... 160
Cole Instrument Co. ...104, 120, 154
Conoflow Corporation 56, 58, 114, 148
Counter & Control Corporation 64
Cramer Company, R. W. ...... 141
Crawford Fitting Co. .......... 145
Crystal Glass Tube & Cylinder Co. ................. 84

Davis Instruments Div., Davis Emergency Equipment Co. .. 83
Derbyshire, Incorporated, F. W. 87
Dietert Co., Harry W. ........ 128
Dillon & Co., Inc., W. C. ..... 161
Doelcam Corporation .......... 123
Drake Manufacturing Co. ...... 104
Dwyer Mfg. Co., F. W. .....73, 90

Eclipse-Pioneer Div., Bendix 97, 113
Edin Company ................. 103
Edison, Inc., Thomas A. ...... 65

(Continued on page 6)

*Instruments* The Magazine of Measurement and Control
is published monthly on the 15th by The Instruments Publishing Co., Inc.
921 Ridge Ave., Pittsburgh 12, Pa.

Richard Rimbach, *Publisher*
M. F. Behar, *Editor*
Milton H. Aronson, *Managing Editor*
James F. Emge, *Assistant Editor*

**MEMBER**
**Audit Bureau of Circulations**

DISTRICT OFFICES AND MANAGERS

James Condon, 133 Marlborough St., *Boston*, Mass. (Commonwealth 6-5961). Richard Rimbach, Jr., Room 349, 551 Fifth Ave., *New York* 17, N. Y. (Murray Hill 2-0821). William J. Gallagher, Room 1102, Beury Bldg., 3701 N. Broad St., *Philadelphia* 40, Pa. (Baldwin 9-9940). Harold W. Haskett, 742 Elberon Ave., *Cincinnati* 5, Ohio (Grandview 4323); Room 615, 360 N. Michigan Ave., *Chicago* 1, Ill. (Andover 3-4299). James R. Wright, 411 North Tenth St., *St. Louis* 1, Mo. (Chestnut 1965), M. D. Pugh, 2721 N. Marengo Ave., *Altadena*, Calif. (Sycamore 7-2894). C. F. Goldcamp, 921 Ridge Ave., *Pittsburgh* 12, Pa. (Fairfax 1-0161). John C. N. Hughes, c/o T. G. Scott & Son, Ltd., 9 Arundel St., London W.C.2, England (Temple Bar 1942).

| SUBSCRIPTION RATES | One Year |
|---|---|
| United States, U. S. Possessions and Canada | $4.00 |
| Latin America and Australia | $5.00 |
| All other countries except those noted below | $6.00 |

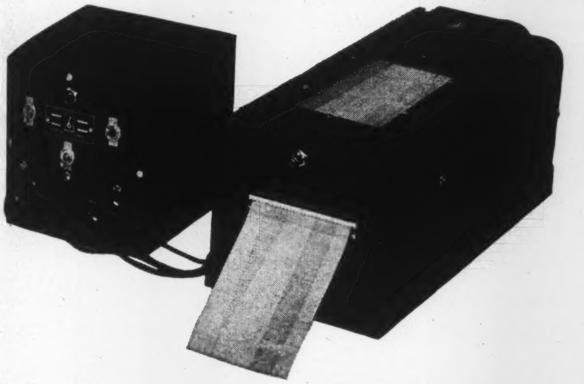
**For the present, subscriptions are not being accepted from Austria, Bulgaria, Czechoslovakia, Germany, Hungary, Poland, Romania, Russia and Yugoslavia.**

Payments from outside the U. S. A. must be in the form of an International Money Order or check on a U. S. bank. Position and company connection as well as products manufactured must be indicated on all subscription orders.

**Copyright 1951 by The Instruments Publishing Company. Entered as second-class matter October 14, 1949, at the post office at Pontiac, Illinois under the Act of March 3, 1879.**

# *Simplify analysis*

# WITH THESE *Brush* INSTRUMENTS



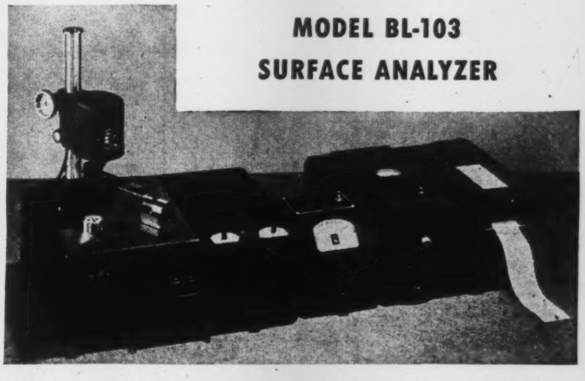
## COMBINATION MAGNETIC OSCILLOGRAPH

The Model BL-221 Single Channel Magnetic Combination Oscillograph is similar to the Model BL-201 unit, except that circuit changes have been made to permit use of either a standard inking pen or an electric stylus. Magnetic penmotor Model BL-943 is used on the BL-221 Oscillograph and includes the proper connections for use of the electric stylus. A Power Supply, Model BL-944, furnishes voltage for the electric stylus operation. A switch on the front panel of the Power Supply permits the operator to increase the stylus voltage when recording high frequency phenomena. The main switch opens circuit to Power Supply to eliminate the possibility of receiving electric shock when handling stylus. Instruments are supplied with a standard pen and inkwell as well as the electric stylus. Oscillographs are available in single, double or six channel models with either inking pens or a combination of inking pen and electric stylus.

## BL-932 D-C AMPLIFIER

Designed for use with the Brush Magnetic Direct Inking Oscillograph, and used to make recordings of many types of phenomena heretofore measured only with the aid of complicated intermediate equipment. Studies of such static or dynamic conditions as strains, displacements, pressures, light intensities, temperatures, d-c and a-c voltages or currents, and many others, are simplified by the use of the Brush Direct Inking Oscillograph with the BL-932 Amplifier. Voltage gain is sufficient to give one chart mm deflection per millivolt input. Novel design features reduce the effects of power line fluctuation. Zero signal drift amounts to not more than one chart mm per hour. Frequency response is essentially uniform from d-c to 100 cycles per second. The control panel at the front of the amplifier contains a factor-of-10 attenuator, gain control, calibrating meter, and controls for determining input voltages. A balancing potentiometer is provided for electrically biasing the oscillograph pen to any position on the chart. A rack mounted version of the DC Amplifier also is available as Model BL-962.

## MODEL BL-103 SURFACE ANALYZER



For exploration and instantaneous charting of surface finishes—metals, glass, plastics, paper, plated and painted surfaces from less than 1 to 5000 microinches. Complete with PA-2 Pickup Arm, Drive Head, Amplifier, Magnetic Oscillograph, Surface Plate, Carrying Cases, Glass Calibration Standard, 2 V-Blocks, 6 rolls Chart Paper, one 2 oz. bottle Red Ink, connecting cords and operating instructions. Brush RMS METER: "average reading" type calibrated in terms of the "RMS" of an equivalent sine wave. It provides a constant visual check of "RMS" surface roughness in cases where "hill and dale" chart profiles are not needed. Large illuminated dial is set at an easy reading angle. "RMS" Meter may be purchased separately or with the Surface Analyzer. Additional qualitative information concerning surfaces may be obtained through the Brush Faxfilm® process.

The Brush Development Company offers you the services of its modern, expertly staffed laboratory for electronics, acoustics, and electro-mechanical instrumentation engineering. Your inquiries are invited.

### BRUSH INSTRUMENTS

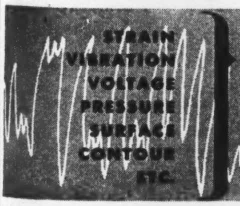
- **BL-103** Surface Analyzer
- **BL-121** Faxfilm Surface Comparator
- **BL-201** Single Channel Direct Inking Oscillograph
- **BL-202** Double Channel Direct Inking Oscillograph
- **BL-206** Six Channnel Magnetic Oscillograph
- **BL-221** Single Channel Combination Magnetic Oscillograph
- **BL-222** Double Channel Combination Magnetic Oscillograph
- **BL-309** Displacement Amplifier
- **BL-310** Strain Gauge Amplifier
- **BL-312** Universal Bridge Switch
- **BL-314A** Textile Uniformity Analyzer
- **BL-320** Universal Strain Analyzer
- **BL-905** AC Amplifier for use with Magnetic Oscillograph
- **BL-928** Dual Channel, Low Gain DC Amplifier
- **BL-932** D-C Amplifier
- **BL-933** Chart Takeup Drive, for use with BL-201, BL-202, BL-221, BL-222
- **BL-502** Transient Recorder
- **BL-301** Vibration Pickup, inertia type
- **DP-1** Vibration Pickup, displacement type
- **DP-1H** Heartbeat Pickup, similar to DP-1, with flat diaphragm
- **BL-942** D-C Amplifier, rack mounting
- **BL-809** Regulated Frequency Power Supply. Many accessories, such as time markers and slow speed drive kits for oscillographs.

### ACOUSTIC AND TEST INSTRUMENTS*

- **BL-2301** Sound Level Recorder
- **BL-1011** Beat Frequency Oscillator
- **BL-4703** Frequency Response Tracer
- **BL-2002** Heterodyne Voltmeter
- **BL-1502** Deviation Test Bridge
- **BL-1507** Deviation Test Bridge

**Mfd. by Brüel and Kjaer, Copenhagen, Denmark*

**THE *Brush* DEVELOPMENT COMPANY**
**DEPT. BB-14, 3405 PERKINS AVENUE • CLEVELAND 14, OHIO, U. S. A.**
*Canadian Representatives:*
A. C. Wickman (Canada) Limited, P. O. Box 9, Station N, Toronto 14, Ontario

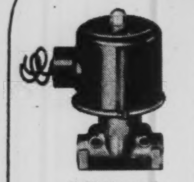


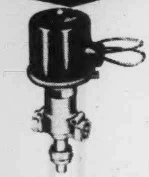
*Put it in writing with a*

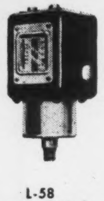
**BRUSH RECORDING ANALYZER**

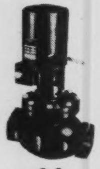
STRAIN ANALYZERS • SURFACE ANALYZERS • CONTOUR ANALYZERS • UNIVERSAL ANALYZERS • UNIFORMITY ANALYZERS

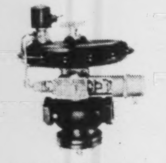
*for better*
**AUTOMATIC CONTROL**
*better check*
**GENERAL CONTROLS**

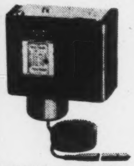

K-21 Magnetic Single Seated Valve


K-15 A Magnetic Piloted Piston Valve

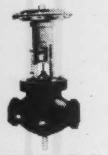

L-58 Pressure Switch

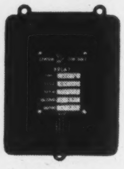

G-2 Hydramotor Valve

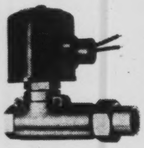

B-55G Governor Type Valve


L-59T Vapor Tension Temperature Control

V-110 Electromagnetic Manual Reset Valve


V-25 Gas Fuel Governor


RS-107 Relay


K-10 Magnetic Lever Valve

Whether for product or process . . . in heating . . . refrigeration . . . industrial processing . . . or aircraft . . . wherever control is a vital factor in performance, General Controls will give you better automatic control for less money. General Controls Design Specialists will welcome inquiries from Design Engineers. Send for Catalog 53 G . . . on your company letterhead, please!

- "All-Gas" Control Systems
- Aircraft Controls, Electric
- Automatic Safety Shut-Off Valves
- Motor Operated Valves
- Magnetic Gas Valves
- Solenoid Valves
- Thermostatic Controls & Control Systems
- Governor-Type Valves
- Hi-Low-Off Valves
- Diaphragm Valves
- Limit Controls
- Electric Time Switches
- Refrigeration Valves
- Gas Regulators
- Low Water Controls
- Strainers, Relays
- Transformers, Switches
- Portable Equipment Controls
- Machine Tool Controls

**GENERAL CONTROLS**
801 Allen Avenue Glendale 1, California
*Manufacturers of Automatic Pressure, Temperature, Level and Flow Controls*
FACTORY BRANCHES: Baltimore 5, Birmingham 3, Boston 16, Buffalo 3, Chicago 5, Cleveland 15, Columbus 15, Dallas 2, Denver 4, Detroit 21, El Paso, Glendale 1, Houston 6, Indianapolis 4, Kansas City 2, Milwaukee 3, Minneapolis 2, Newark 6, New Orleans, New York 17, Omaha 2, Philadelphia 23, Pittsburgh 22, Salt Lake City 4, St. Louis 3, San Francisco 7, Seattle 1, Tulsa 6, Washington 6, D.C. DISTRIBUTORS IN PRINCIPAL CITIES

# ADVERTISERS' INDEX

(Continued from page 4)

Electric Hotpack Co., Inc. .... 40
Electric Indicator Co. .......... 95
Electro Mechano Co. .......... 126
Electro-Medical Laboratory, Inc. 53
Electro Products Laboratories .. 107
Electronic Engineering Associates 50
Emery Co., A. H. ............ 133
Emmett Machine & Manufacturing, Inc. .................. 27
Engineering Research & Development Co. .................. 44
Eppley Laboratory, Inc. ....... ........Inside Front Cover, 51
Erb & Gray ................. 93
Evaporated Metal Films Corporation ............... 100

Falstrom Co. ................ 25
Farris Engineering Corp. ...... 149
Farris Stacon Corp. .......... 63
Federal Products Corp. ...... 72
Fenwal Incorporated .......... 26
Ferrier Engineering .......... 127
Fish-Schurman Corp. .......... 98
Fisher Research Laboratory, Inc. 104
Flexible Valve Corp. .......... 148
Food Technology Inc. .......... 53
Ford Engineering Co. .......... 106
Foxboro Co. ................ 23
Freas Glass Works, Francis L. 135

Gaertner Scientific Corp. ...... 165
Geier & Bluhm, Inc. .......... 88
General Controls Co. .......... 6
General Electric Co. .......... 20
Genisco Incorporated .......... 42
Giannini & Co., Inc., G. M. ... 106
Gorrell & Gorrell ............ 140
Gotham Instruments, Div. of American Machine & Metals, Inc. .................... 29
Gow-Mac Instrument Co. ...... 81
Gramer Transformer Corp. .... 142
Green Instrument Co. .......... 69
Guardian Electric Mfg. Co. .... 117
Gustafson Mfg. Co., G. D. ..... 142

Hagan Corp. ................ 3
Haydon Company, A. W. ...... 43
Hays Corp. ..............61, 81, 83
Heiland Research Corp. ....... 101
Heise Bourdon Tube Co. ...... 74
Helicoid Gage Div., American Chain & Cable Co. 75
Helipot Corporation .......... 104
Henson Company, Fred C. ..... 166
Hickok Electrical Instrument Co. ......................45, 47
Hycon Mfg. Company .......... 102

Ideal Laboratory Tool & Supply Co. .................... 34
Illinois Testing Laboratories, Inc. .................... 13
Industrial Div., Minneapolis-Honeywell Regulator Co. 56, 62, 78, 91, 92, 106, 108, 110, 1T4, 138, 143, 150
Industrial Electronics, Inc. ...16, 17
Industrial Instruments, Inc. ... 40
Industrial Pyrometer & Supply Co. 61
Industrol Corporation .......... 43
Ingersoll-Rand Company ....... 22
Instrument Laboratories ....... 44
International Rectifier Corp. ... 114

J-B-T Instruments, Inc. ...... 156
Jeffrey Manufacturing Company. 69
Jerguson Gage & Valve Co. ... 72
Jo-Bell Products, Inc. ......... 40
Johnson-Williams, Ltd. ....... 82

Karn Chemical Equipment Company .................. 138
Kaydel Moisture Gauges ...... 94
Kepko Laboratories, Inc. ....... 1
Kieley & Mueller, Inc. ........ 57
King Engineering Corporation 73, 89

Lambda Electronics Corp. ..... 106
Lawter Chemicals, Inc. ........ 169
Leslie Co. .................. 147
Lewis Engineering Co. ..............Outside Back Cover
Librascope, Incorporated ....... 58
Littelfuse, Inc. .............. 86

MacDonald Co., Inc., W. S. .. 63
Magnecord, Inc. .............. 113
Magnetrol, Inc. .............. 62
Mann Co., Wm. I. ............ 169
Marsh Corp., Jas. P. .......79, 137
Marshalltown Mfg. Co. ....... 79
Maxson Corporation, W. L. ..... 105
Measurements Corp. ...... Inside Back Cover, 69, 82
Mercoid Corp. .............. 30
Meriam Instrument Co. 77, 89, 90, 92
Merkle-Korff Gear Co. ......... 94
Millivac Instruments .......... 150
Milo Radio & Electronics Corp. 38

Mine Safety Appliances Co. ... 8
Minneapolis-Honeywell Regulator Co. 56, 62, 78, 91, 92, 106, 108, 110. 114, 138, 143, 150
Mittelmann Electronics Division, Century America Corp. ...... 71
Moeller Instrument Co. ....... 33
Moore & Company, Samuel .... 144

Nash Engineering Co. ......... 11
National Instrument Laboratories 92
New Hermes, Inc. ............ 80
Norcross Corporation .......... 64
Nuclear Instrument & Chemical Corp. ............ 96
Optron Laboratory ............ 100

Pacific Div., Bendix .......... 118
Pacific Universal Products Corp. 98
Palmer Thermometers, Inc. ..... 21
Passaic Analytical Laboratories Inc. ..................... 86
Perkins & Son, Inc., B. F. .... 130
Permo, Incorporated .......... 154
Philadelphia Thermometer Co. . 137
Philamon Laboratories ......... 145
Philbrick Researches, Inc., George A. .................. 54
Photron Instrument Company ... 101
Pittsburgh Instrument & Machine Co. ............... 132
Potter Aeronautical Co. ...... 70
Potter & Brumfield Mfg. Co. ... 119
Powers Regulator Co. 59, 136, 151
Precise Company ............. 84
Precision Tube Co., Inc. ....... 146
Preis Engraving Machine Co., H. P. ..................... 68
Pritchard & Company, J. F. .. 43
Pyrometer Instrument Co. ...... 100

Rahm Instruments, Inc. ...... 143
Rawson Electrical Instrument Co. 152
Republic Flow Meters Co. ....... 55, 74, 92, 115, 142, 149
Rex Rheostat Co. ............ 120
Richards Co., Inc., Arklay S.. 134
Rochester Mfg. Co., Inc. ...... 135
Rockwell Co., W. S. ......... 146
Rockwell Mfg Co. ............ 35
Roller-Smith Corporation ..... 48

Sampson Chemical & Pigment Co. 38
Sanborn Co. ................ 112
Schneider-Cogswell, Inc. ....... 98
Seedburo Equipment Co. ...... 93
Service Recorder Co. ......... 139
Shore Instrument & Mfg. Co. .. 131
Shurite Meters .............. 44
Simpson Electric Co. ......... 152
Simpson Optical Mfg. Co. ...... 99
Smith Corporation, A. O. ..... 79
Soreng Manufacturing Corp. ... 123
Specialty Battery Co. ......... 49
Standard Cabinet Co. ......... 51
Standard Electric Time Co. ... 140
Steinen Mfg. Co., Wm. ....... 174
Stevens Arnold Inc. .......... 53
Stewart Manufacturing Corp., F. W. .................... 174
Sticht Co., Inc., Herman H. 126, 127
Streeter-Amet Co. ........... 139
Superior Controls Co., Inc. ... 137
Superior Tube Co. ........... 31

Taco-West Corporation ....... 63
Taylor Instrument Companies ..............Outside Front Cover
Technical Associates .......... 97
Techno Instrument Company ... 177
Television Equipment Corp. ... 102
Tenney Engineering, Inc. ...... 52
Thermo Electric Co., Inc. .... 134
Tinsley Laboratories .......... 98
Tracerlab, Inc. .............. 24
Trimount Instrument Company . 88
Trinity Equipment Corp. ...... 139
Triplett Electrical Instrument Co. 42
Turner Electric Co., E. W. 101, 138

Uehling Instrument Co. ....... 78
Ulanet Company, George ...... 140
Ultrasonic Engineering Co. 82, 103
Unertl Optical Co., John ...... 98
Uniform Tubes ............... 144
United States Gauge, Div. of American Machine & Metals, Inc. ..................... 39
Vapor Recovery Systems Co. .... 77
V. & E. Manufacturing Co. ... 66

Wallace & Tiernan Products, Inc. ...............45, 74, 79, 89, 147
Warrick Co., Charles F. ......... 61
Waterman Products Co., Inc. ... 32
Weksler Thermometer Corp. .... 136
Welch Scientific Co., W. M. ... 147
Westberg Mfg. Co. ........... 124
Weston Electrical Instrument Corp. ..................... 7
Wheelco Instruments Co. 56, 58, 110

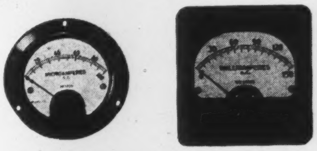
Zeiss, Inc., Carl ............. 93

# To do important measurement jobs

# *Better... Quicker!*

***Model 697* VOLT-OHM-MILLIAMMETER** One of a line of pocket-size meters, Model 697 combines a selection of a-c and d-c voltage, d-c current, and resistance ranges. Ideal for maintenance testing and many inspection requirements.

***Model 686* ELECTRONIC TUBE ANALYZER** tests tubes under exact operating potentials. Accurately determines true mutual conductance of all tubes, in accordance with manufacturers' rated operating conditions, or under desired operating conditions.



**PANEL and SWITCHBOARD INSTRUMENTS**—a complete line of instruments in all types, sizes and ranges required for switchboard and panel needs... including d-c, a-c power frequencies and radio frequency, rectifier types and D.B. meters.

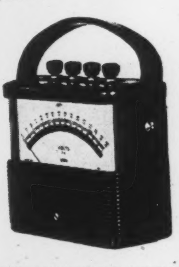
***Model 622* ULTRA-SENSITIVE INSTRUMENTS**—portable d-c and a-c thermo instruments for precision measurement of potentials and minute currents in electronics or laboratory research.

The same *dependability* evident in all WESTON standard instruments also is available in a broad line of *specialized* and *multi-purpose* instruments...all designed to do special and complex measurement jobs better, quicker, more economically. Whether for laboratory, shop or field requirements, first check instrument needs with WESTON. Consult the nearest representative, or write direct.

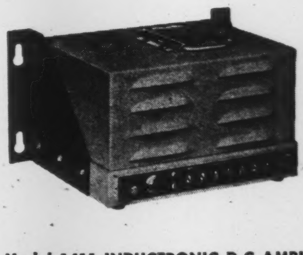
# WESTON *Instruments*

WESTON Electrical Instrument Corporation
642 Frelinghuysen Avenue, Newark 5, New Jersey
*Manufacturers of Weston and TAGliabue Instruments*

**SENSITIVE RELAYS**—a line of sensitive relays including the Model 705 which provides positive control at levels as low as ½ microampere. Non-chattering magnetic contacts handle up to 10 watts at 120 volts.



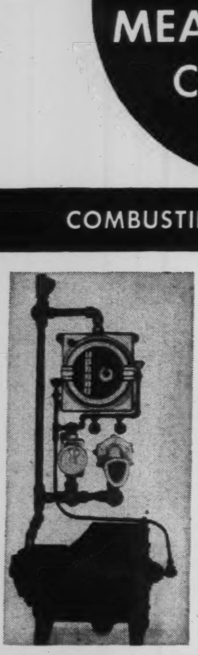
***Model 901* PORTABLE TEST INSTRUMENTS** available in d-c, Model 901—and a-c, Model 904, single and multiple ranges of wide coverage. Excellent scale readability and shielding. Accuracy within ½ of 1%.



***Model 1411* INDUCTRONIC D-C AMPLIFIER**—stable amplifier provides high degree of resolution even at fractional loads. Reaches steady full scale deflection in fraction of a second. Interchangeable plug-in range standards for either microamperes or millivolts.

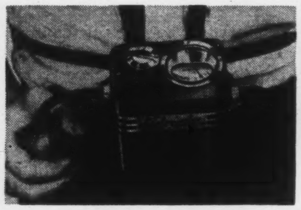
For Accurate
DETECTION
MEASUREMENT
CONTROL
of Industrial Atmospheric Hazards
Specify Dependable
M·S·A INSTRUMENTS

COMBUSTIBLE GASES



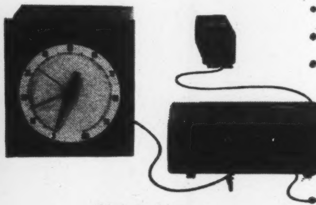
**M.S.A. Combustible Gas Alarm**

This widely-used instrument assures safe, continuous sampling of atmospheres for combustible gases and vapors. Its explosion-proof construction permits installation in hazardous areas. Visual and audible warning when concentrations exceed predetermined percentage of lower explosive limit. The Alarm may be wall mounted, if desired, and can be arranged for multi-point sampling with one instrument. Bulletin No. DT-6.



**M.S.A. Explosimeter**

Accurate, one-hand operation for detecting and measuring flammable gas hazards and for locating gas leaks. Designed for day-in, day-out use. Compact, light weight, sturdy, easy to use. Meter is calibrated for easy reading. Ask for Bulletin No. DN-7.



**M.S.A. Lira**

This infra-red gas and liquid analyzer is ideal for measuring atmosphere contamination and for process control. It is extremely accurate, with rapid response to changing concentrations. Designed for permanent installation and continuous recording. Bulletin No. DZ-4.

TOXIC GASES

**M.S.A. Carbon Monoxide Tester**

Employing the most advanced colorimetric method of carbon monoxide detection, this accurate instrument will indicate CO in air from 0.001 to 0.10 percent by volume. Simple to use; requires no special training. Accurate in the presence of water and gasoline vapors. Bulletin No. BY-1.

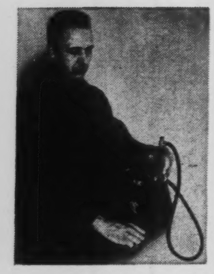
**M.S.A. Carbon Monoxide Alarm**

Whenever carbon monoxide reaches a predetermined concentration, this precision instrument gives a prompt, loud warning and visible indication. Designed for 24 hour service, the unit is enclosed in a weather-proof case. Bulletin No. DR-2.

**M.S.A. Hydrogen Sulfide Detector**

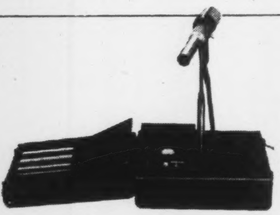
Quick detection and accurate measurement of low but dangerous concentrations of hydrogen sulfide in air and process gases. Detects amounts ranging from 0.0025 to 0.04 percent by volume. Supersensitive models available for 0 to 50 p.p.m. Bulletin No. DY-3.

HARMFUL DUSTS



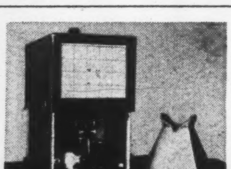
**M.S.A. Midget Impinger**

A compact, easy to operate intrument for obtaining accurate samples of particulate matter. Samples at the rate of 1/10 cubic feet per minute. Portable, self-contained, this unit is ideal for dust control and survey work. Bulletin No. CT-6.



**M.S.A. Dust-Vue Microprojector**

Permits rapid, easy counting of dust particles in collected samples, and particle size determination. Magnifies to 1000 times in size on ruled translucent screen—relieves eye-strain and permits greater accuracy. Bulletin No. CT-7.



**M.S.A. Electrostatic Sampler**

High efficiency in atmospheric sampling for all types of particulates including dust and fumes from molten metal and smoke. Features a portable head for sampling at various levels. Convenient to carry. Bulletin No. CT-9.

**MINE SAFETY APPLIANCES COMPANY**
**Braddock, Thomas and Meade Sts., Pittsburgh 8, Pa.**
*At Your Service:* 48 BRANCH OFFICES in the UNITED STATES
**MINE SAFETY APPLIANCES CO. OF CANADA LIMITED**
**Toronto, Montreal, Calgary, Winnipeg, Vancouver, New Glasgow N. S.**
Representatives in Principal Cities in Mexico, Central and South America
CABLE ADDRESS: "MINSAF" PITTSBURGH

MSA
SAFETY EQUIPMENT HEADQUARTERS

# BLACK, SIVALLS & BRYSON, INC.

# "Climax" Controls Division

## BS&B "Climax" diaphragm control valves

**TYPE 86 DIAPHRAGM CONTROL VALVE** is used with instruments to control flow, temperature, pressure, and liquid level . . . to handle air, gas, vapor, steam or liquid . . . in all types of systems. It is designed with high lift characterized inner valves to obtain wide rangeability and constant proportional flow increase as valve opening increases with travel.

### SPECIFICATIONS

Body size: Double port, ½" to 16". Single port, ½" to 4".

Body style: Screwed globe or flanged globe.

Pressure range: 125 to 5000 lbs. within body size limits.

Temperature: Up to 800° F.

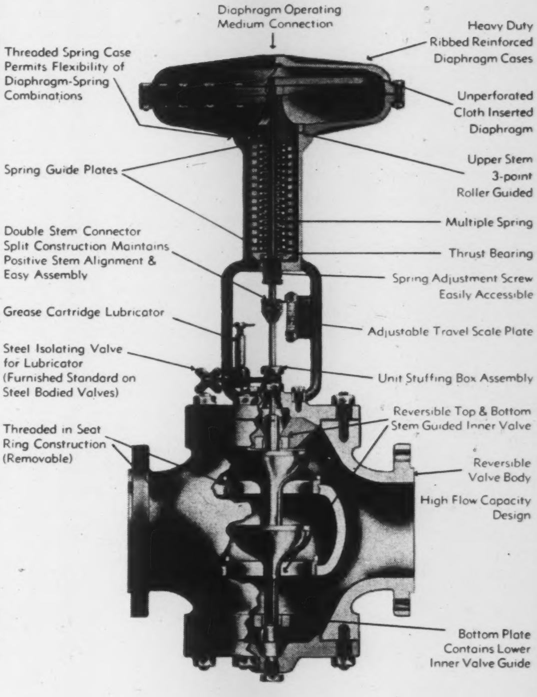
Diaphragm pressure: 3 to 15 lbs., standard.

Material: Body—high tensile cast iron, electric cast steel, or special alloys. Trim—bronze or 18-8 stainless steel or special alloys.

When specific applications are desired, add the following letter or letters to the type number of the valve:

D: Direct acting valve (normally closed)
R: Reverse acting valve (normally closed)
DRT: Reverse topworks
H: Handwheel on diaphragm case (limits travel away from valve body)
M: Handwheel on lower body plate (limits travel into valve body)
F: Finned cooling section
PG: Purge gland section

When ordering, please specify: type, size, style, material, port design, inner valve design, diaphragm range, special appliances, maximum pressure, inlet pressure range, outlet pressure range, normal operating inlet-outlet pressure, and the volume, gravity, and temperature of the flowing medium through body.


Diaphragm Operating Medium Connection
Threaded Spring Case Permits Flexibility of Diaphragm-Spring Combinations
Heavy Duty Ribbed Reinforced Diaphragm Cases
Unperforated Cloth Inserted Diaphragm
Spring Guide Plates
Upper Stem 3-point Roller Guided
Multiple Spring
Double Stem Connector Split Construction Maintains Positive Stem Alignment & Easy Assembly
Thrust Bearing
Spring Adjustment Screw Easily Accessible
Grease Cartridge Lubricator
Adjustable Travel Scale Plate
Steel Isolating Valve for Lubricator (Furnished Standard on Steel Bodied Valves)
Unit Stuffing Box Assembly
Reversible Top & Bottom Stem Guided Inner Valve
Threaded in Seat Ring Construction (Removable)
Reversible Valve Body
High Flow Capacity Design
Bottom Plate Contains Lower Inner Valve Guide

## specifications

| Type | Body Size | Body Style | Pressure Range | Temperature | Diaphragm Pressure | Material |  | Special Arrangements |
|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  |  | Body | Trim |  |
| 86 | DP ½" to 16"<br>SP ½" to 4" | Screwed Globe or Flanged Globe | 125 lbs. to 5000 lbs. Within Body Size Limits | Up to 800° F. | 3 lbs. to 15 lbs. Standard | High Tensile Cast Iron, or Electric Cast Steel, or Special Alloys | Bronze or 18-8 Stainless Steel or Special Alloys | -D, R. -RM,<br>-DF -DFM,<br>-RF, -RFM,<br>-DH, -DRT,<br>-RH, -DRTF,<br>-DFH, -DPG,<br>-RFH, -RPG,<br>-DM, -DRTPG |
| 15 | SP 1", 1½" and 2" | Screwed Globe, Screwed Angle, and Flanged Angle | 3000 lbs.<br>6000 lbs. | @ 100° F.<br>@ 100° F. |  | Forged Steel, or Electric Cast Steel | Regular 18-8 Stainless Steel; Special Alloys on Request | -D<br>-DRT<br>-DF<br>-DRTF |
| 1515 | ¼", ⅜", ½" ¾" and 1" | Screwed Globe or Angle | 3000 lbs. | @ 100° F. |  | Forged Steel, or Special Alloys | Stainless Steel; Special Alloys on Request |  |
| 1286 | 1" to 8" | Three Way Control | 125 to 600 lbs. Pressure Drop Limited | Up to 800° F. |  | High Tensile Cast Iron and Cast Steel or Special Alloys | Stainless Steel and Bronze or Special Alloys |  |
| 73 | DP ½" to 16"<br>SP ½" to 4" | Screwed and Flanged Globe. Can be loaded directly or through a pressure pilot | 125 to 5000 lbs. Within Body Sizes | Up to 800° F. | Maximum 50 lbs. | High Tensile Cast Iron or Electric Cast Steel and Special Alloys | Bronze or 18-8 Stainless Steel or Special Alloys |  |

For further information on BS&B "Climax" Diaphragm Control Valves, write for Catalog Section 105.

# BLACK, SIVALLS & BRYSON, INC.

## BS&B "Climax" displacement liquid level controllers

**The Climax Type 888 Controller** is recommended for all types of liquid level control applications involving exacting and wide range control. It utilizes torsion tube assembly for transmitting level changes . . . eliminates objectionable packing glands and pressure type bearings. It is designed for control of levels from minimum variations of ¼" up to "wide range" variation of 120 inches. It operates on liquid specific gravities ranging from .05 to 2.0 with standard displacement elements.

### FEATURES

Torque tube is adjustable and easily replaced. Torque tube housing is removable and reversible in the field. Two torque tubes can be used on a single unit.

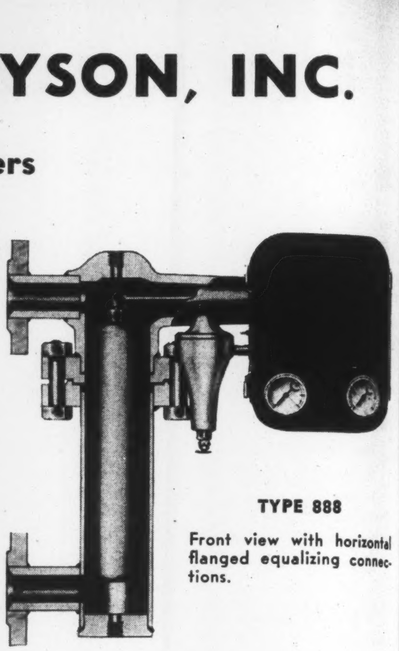
Cone point and connector are rugged, friction-free, and easily replaced. Includes a new single point cone suspension pivot.

Long displacement arm and long heavy torque tube combine to provide long life and greater accuracy of control. Displacement element is of heavy wall steel tube with dished caps welded into ends for long life and high pressures.

Element cage has been reduced in size but heavier walls and smaller flanges greatly increase the safety factor of the controller.

### APPLICATIONS

1. For "inter-face" or "duo-gravity" level control of two non-miscible liquids of different specific gravities.
2. For specific gravity control or indication where liquid densities may be maintained within range of the controller.
3. For indication of liquid level positions where handling corrosive liquids, or at remote points on vessels not easily visible for observation of sight glasses.
4. To indicate full range level position when used with Type 1400 pilot.
5. To reset "rate of flow" controllers.
6. For safety alarm or shutoff.
7. For dual pilots. Two torque tubes with appropriate pilots and switches can be used with a single controller.
8. For "on-off" valve operation.



**TYPE 888**

Front view with horizontal flanged equalizing connections.

**TYPES 887 and 889 Controllers** are internal mounted and recommended where corrosive conditions preclude the use of external piping. Construction details are same as Type 888 except that no cage is included and provisions are made for positioning the displacement element at the required level in the vessel.

For further information on BS&B "Climax" Displacement Liquid Level Controllers, write for Catalog Section 103.

## BS&B "Climax" continuous drainers

**Climax Continuous Drainers** are designed for duo-phase or duo-gravity draining of water, condensate or oils. When inverted, they can be used as vent traps.

The bodies are constructed of semi-steel or cast steel. Float is of stainless or nickel-plated steel. Other metals or alloys available upon request. The float movement is transplanted to the inner valve by means of the toggle attached to the float rod toggle. BS&B also manufactures internal float and drainer assemblies.

The head plate valve and float assembly of some types can be furnished alone for use on vessels or tanks equipped with an 8-inch nozzle to match the head drilling.

**TYPES 90 DUO-PHASE and 91 DUO-GRAVITY.** Equalizing connections: 1" or 1½". Outlet: ¾". Float: 7¾" diameter*. Orifice: 1/16" to ¾". Working pressure: Cast iron, 150# @ 350° F. Cast steel, 500# @ 450° F. Especially adaptable for use as steam traps.

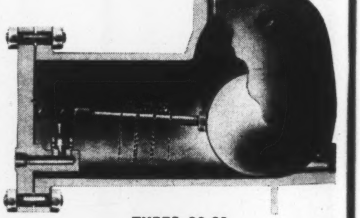
**TYPES 140 DUO-PHASE and 141 DUO-GRAVITY.** Equalizing connections: 1½" or 2". Outlet: 1". Float: 7¾" diameter*. Orifice: 1/16" to ⅞". Working pressure: Cast iron, 250# @ 460° F. and 400# @ 100° F. Cast steel, 300# @ 800° F. and 600# @ 100° F.

**TYPES 440 DUO-PHASE and 441 DUO-GRAVITY.** Equalizing connections: 1½" or 2". Outlet: 1". Float: 7¾" diameter*. Orifice: 1/16" to ⅞". Max. working pressure: Up to 1500# @ 100° F. if the required drainer orifice is not so large that differential pressure against the closed valve cannot be overbalanced by float buoyancy.

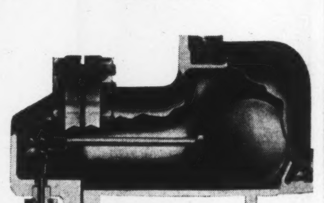
**TYPE 146-D.** Valve body size: ½" to 2" screwed globe, and 1½" and 2" flanged globe. Float: 7¾". Equalizing connections: 1½" or 2" NPT. Maximum working pressure: 1000# @ 100° F. or rating of valve body. Utilizes drainer body and float construction of Type 140 with a complete valve body connected to the float arm through a swivel coupling for handling larger volumes of flow.

* Floats 91, 141, and 441 are weighted to sink in liquid of gravities higher than 40° API (.825 Sp. Gr.) and float on water.

For further information on BS&B "Climax" Drainers or Vent Traps, write for Catalog Section 101.



**TYPES 90-91**

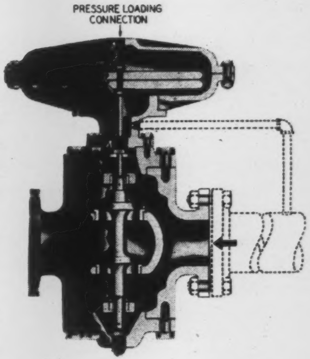


**TYPE 146-D**

# "Climax" Controls Division

## BS&B "Climax" self-operated regulators

### TYPE 96 D/R SIMPLEX PRESSURE BALANCE DIAPHRAGM REGULATOR



The Type 96 Regulator is recommended for exacting temperature control applications. It is used with temperature controllers where a design permitting reset of position of inner valve with minimum friction or hysteresis is required to give sensitivity control in the highest degree. It is also used with pressure controllers for reducing or back pressure service.

**CONSTRUCTION**

Standard construction includes high tensile cast iron or cast steel body, bronze or 18-8 stainless steel trim, quick opening double port, top and bottom guided metal seat inner valves. Heat treated stainless or composition inner valves may be furnished on special order. Bodies and trim are fully reversible, making it possible to convert a direct to a reverse acting regulator and vice versa without additional parts.

Sizes: ½" to 2" screwed globe. 1" to 10" flanged globe (ASA).

Maximum inlet pressure: 300#.

Controlled pressures: 4" water to 25#.

Maximum temperature: 150° F. or 450° F. with fins.

### TYPE 77 REDUCING REGULATOR

The Type 77 Regulator is designed for supersensitive pressure control. It is recommended for engine fuel pressure control, Channel Black burner pressure control, and other pressure control services requiring the highest degree of sensitivity. It is pilot loaded, pressure balanced, and diaphragm actuated.

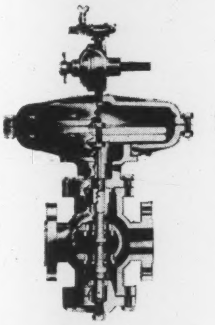
Standard construction is same as Type 96 D/R.

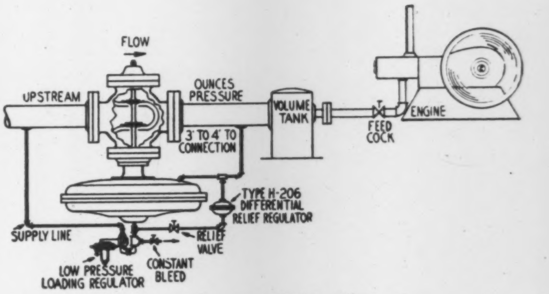
Sizes: ½" to 2" screwed globe. 1" to 10" flanged globe (ASA).

Maximum inlet pressure: 100#.

Controlled pressures: 2 to 25#.

Maximum temperature: 150° F.



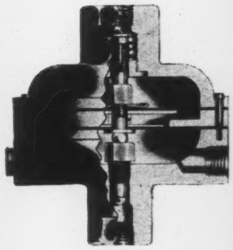


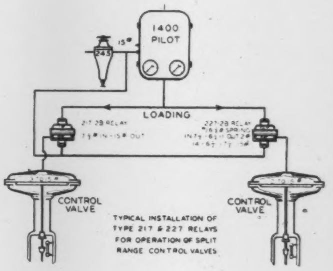
*Type 77 — Installation Diagram*

## BS&B "Climax" relay regulators

### TYPE 227 DELAYED ACTION RELAY, FIXED RATIO

Type 227 Relays are designed primarily for use with diaphragm control valves when they are required to operate in series: i. e. through "split range." By use of one or more Type 227 relays with a Type 217 relay, control valves with a standard range (3 to 15 lbs.) can be fully travelled with primary control pressure changes as low as two or three pounds. A typical installation of this relay applied to split range valves is shown at the right.





TYPICAL INSTALLATION OF TYPE 217 & 227 RELAYS FOR OPERATION OF SPLIT RANGE CONTROL VALVES

Through its various diaphragm assemblies, The Type 227 Relay offers a selection of ratios—1:1, 1:2, 2:1, 1:3, 3:1, 1:4, 4:1 — to meet demands of control pressures beyond the range of usual instrument pressures.

Standard construction: body and diaphragm casing: cast bronze. Inner valve assembly: stainless steel. Diaphragms: Oil-resistant Neoprene. Incorporated in the relay is a spring of sufficient power to delay opening of the output port until a certain fixed loading pressure has been reached. This fixed spring loading is permanently absorbed and only loading pressures above the pressure absorbed by the spring will affect the relayed ratios.

All pipe connections are ¼" NPT.

Maximum supply pressure is 200#.

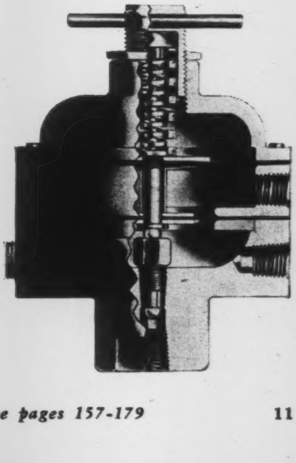
### TYPE 228 REVERSE ACTION RELAY

Type 228 Relay is used for delivering maximum pressure output at minimum pressure input from pilot or other controlling source—or vice versa—without modification of any kind in either pilot or valve hookup.

If reversal of valve closure in relation to pilot action is required from time to time, installation of this relay in a bypass line will provide a simple, fast, and inexpensive method of accomplishing the change.

Standard construction includes, case, top, and non-wearing parts of bronze. Ratio plates, inner valve and seats are of stainless steel. Diaphragms are of nylon-inserted neoprene.

Connections: ¼" NPT. Range: 2 to 30#.



# "Climax" Controls Division

## BS&B "Climax" pressure controllers

**TYPE 1400 PRESSURE CONTROLLER (Non-recording)** handles both positive an negative pressures—from high vacuum to 10,000#. Bourdon tube operated, Type 1400 is suited for operations requiring highest sensitivity or where throttling ranges are necessary to dampen sensitivity. Type 1400 overcomes cyclic or hunting action where conditions make "lined-out" pressure control difficult.

This controller is also suitable for vacuum relief control, vacuum control, fluid pressure control, boiler steam pressure control, off-and-on control, and snap-action where the two limits may each be set at any desired pressure up to 25% of Bourdon tube rating.

Range: Vacuum to 10,000# working pressure.

Throttling Range: Adjustable 0-200 per cent.

Available Bourdon Tube Ratings in Lbs.: 30, 60, 100, 300, 500, 750, 1000, 1500, 2000, 3000, 5000 and 10,000.

For further information on BS&B "Climax" Pressure Controllers, write for Catalog Section 110.

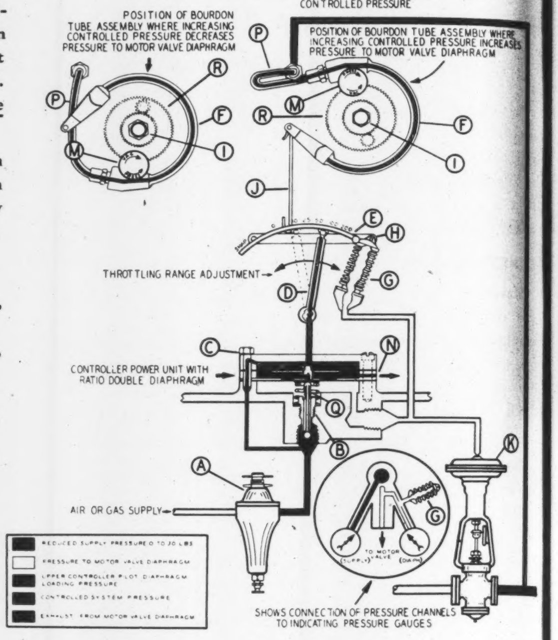
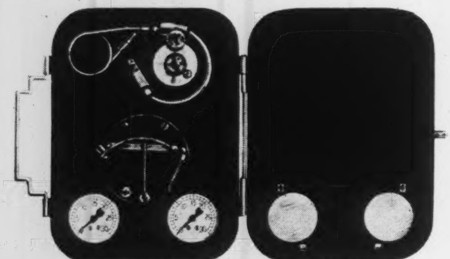
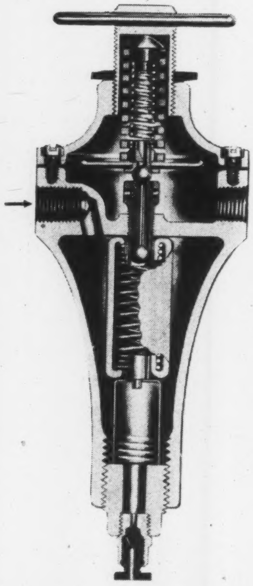


DIAGRAM ILLUSTRATING FLOW THROUGH CONTROLLER
CONTROLLED PRESSURE
POSITION OF BOURDON TUBE ASSEMBLY WHERE INCREASING CONTROLLED PRESSURE DECREASES PRESSURE TO MOTOR VALVE DIAPHRAGM
POSITION OF BOURDON TUBE ASSEMBLY WHERE INCREASING CONTROLLED PRESSURE INCREASES PRESSURE TO MOTOR VALVE DIAPHRAGM
P
R
F
M
I
J
E
H
G
D
THROTTLING RANGE ADJUSTMENT
C
N
CONTROLLER POWER UNIT WITH RATIO DOUBLE DIAPHRAGM
Q
B
K
A
AIR OR GAS SUPPLY
TO MOTOR VALVE
(SUPPLY)
(DIAPH)
SHOWS CONNECTION OF PRESSURE CHANNELS TO INDICATING PRESSURE GAUGES
REDUCED SUPPLY PRESSURE 0 TO 30 LBS
PRESSURE TO MOTOR VALVE DIAPHRAGM
UPPER CONTROLLER PILOT DIAPHRAGM LOADING PRESSURE
CONTROLLED SYSTEM PRESSURE
EXHAUST FROM MOTOR VALVE DIAPHRAGM



## BS&B "Climax" auxiliary regulators

### TYPE 245 SUPPLY MEDIUM REDUCING REGULATOR



The Type 245 Regulator features an integral strainer and a relief valve in the diaphragm. Dual loading springs give sensitive control at both high and low settings within the specified control range. The regulator is standard equipment on all BS&B Pressure Pilots, Level Control Pilots, and Time Cycle Controls unless otherwise specified.

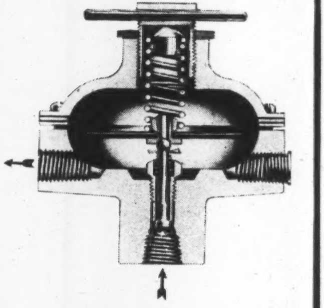
**MATERIALS**

Body and cap: Cast aluminum.
Inner valve assembly: Stainless steel.
Diaphragm backup plate: Stainless steel.
Diaphragm: Neoprene.
Springs: Cadmium-plated steel.

**SPECIFICATIONS**

Size 1/4".
Maximum Inlet Pressure: 300#.
Reduced Pressure Range: 2 to 50#.
(Special springs available for higher reduced pressure ranges.)
Volume Sediment Chamber: 6.3 cubic inches

### TYPE 216 PILOT SUPPLY REDUCING REGULATOR



**TYPE 216 REGULATOR** is designed without the strainer-drip chamber and has a large diaphragm area for sensitive control pressures. It is extensively used on diaphragm actuated-pressure loaded regulators as the loading regulator or "pilot", and may be used in any service requiring accurate control within ranges specified.

**SPECIFICATIONS**

Size: 1/4".
Maximum Inlet Pressure: 300#.
Reduced Pressure Range: 2 to 30#.

For further information on BS&B "Climax" Auxiliary Regulators, write for Catalog Section 107

# BLACK, SIVALLS & BRYSON, INC.

15 N. Cincinnati St., Tulsa, Oklahoma

# Alnor POINTS with PRECISION

**Constant Millivolt Characteristics**

over a wide range of ambient temperatures are assured by a high manganin to copper ratio plus a series negative temperature coefficient resistor. Automatic cold end compensator adjusts for changes in ambient temperature during a test.

**Low Contact Resistance**

The selector switch is of heavy duty construction designed for a low and constant value of contact resistance . . . of prime importance when high accuracy is required. Multi-point switch is housed in separate compartment in the case which also contains a high grade mercury in glass thermometer.

**Direct Reading**

Just turn the switch to the desired circuit and read the temperature directly—no balancing operations or conversion charts. Large 6″ scale face is easily and quickly read. Knife edge pointer and mirror eliminate parallax errors. Single or double scale ranges available. Illinois Testing Laboratories, Inc., Rm. 518, 420 N. La Salle St., Chicago 10, Illinois

**Overlapping Contacts**

When switching from one circuit to another, the new circuit is made before the old is broken . . . the meter circuit is never opened during switching, thus eliminating the possibility of damage due to excessive and wild pointer swing.

## portable multi-circuit Pyrometer

Combining portability with precision laboratory performance, Alnor Portable Multi-Circuit Pyrometers make possible accurate temperature measurement at a multiplicity of points in rapid succession. Type 1200 Pyrometer is particularly valuable in reading temperature rise of various portions of an electrically operated device or repetitive tests on a production run of closely controlled units.

Featuring modern design and rugged construction throughout, Alnor Pyrometers have precision-built double air gap movements of exceptionally high internal resistance . . . famous Alnico magnets . . . the finest in sapphire bearings and hardened steel pivots. Ask your Alnor representative for complete details and prices on these accurate and reliable instruments.

Type 1200 precision-built, self-contained, portable that gives instant, accurate readings of temperatures at a number of points in rapid succession. Available with 8 or 17 circuits. Scale ranges from 0-300° to 0-3000° F. and their centigrade equivalents.

Type 1000 Portable Resistance Thermometer with 8 circuit switch for low temperature service. Available in a variety of ranges between —100° F. and +400° F. A span as small as 50° F. can be supplied.

**ILLINOIS TESTING LABORATORIES, INC.**

**Alnor**

**PRECISION INSTRUMENTS FOR EVERY INDUSTRY**

Illinois Testing Laboratories, Inc.
Room 518, 420 N. LaSalle St., Chicago 10, Ill.

☐ Send Bulletin. ☐ Have an Alnor representative call.

Name.........................................

Company.........................................

Address.........................................

City.............................Zone....State.........

# Century INDUSTRIAL

## FOR VIBRATION, STRESS, TEMPERATURE,

### MODEL 408 OSCILLOGRAPH

The Century Model 408 recording oscillograph was designed expressly for airborne and mobile operation. As with all Century products, this oscillograph incorporates the utmost in design and workmanship, along with improved features, yet it remains simple in its operation and maintenance.

**FEATURES:**

Size: 20″ long, 12½″ wide, 8⅞″ high.

Weight: 51 pounds.

Number of Recording Channels: 6 to 48.

Detachable daylight loading magazine accommodating a roll of paper or film 8″ x 200′.

Friction roller type paper drive by governor controlled electric motor with separate motor for takeup drive.

Paper speeds continuously and instantly variable without changing gears or sprockets.

Separate optical system for viewing before or during recording.

Glow tube timing system photographing .01 second and .1 second lines. .01 second lines instantly removable by toggle switch for slower speeds.

Data numbering at beginning of record.

Footage indicator showing amount of paper remaining in magazine.

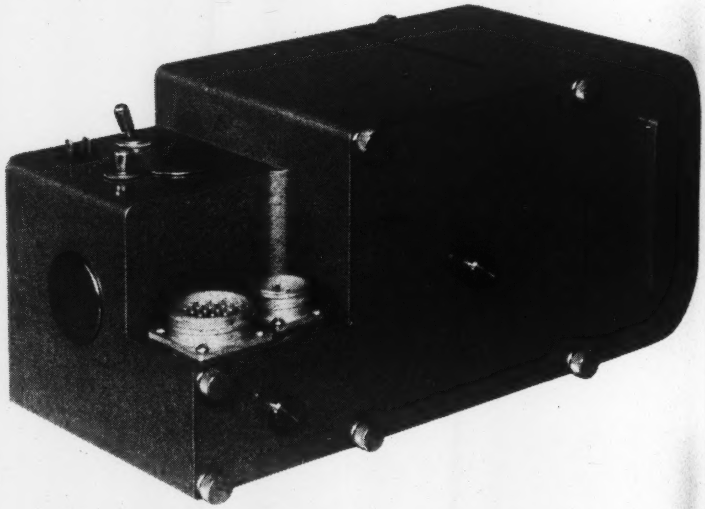
Automatic record length control.

Trace identification.

Remote control unit.

### MODEL 409 OSCILLOGRAPH

The Century Model 409 oscillograph has been designed for recording data where space and weight requirements are limited. This oscillograph has been tested to record faithfully while subjected to accelerations up to 20 G's.



**FEATURES:**

Size: 5″ x 5″ x 11″.

Weight: 11 pounds.

Cast Aluminum case.

Paper speeds instantly variable $1/2$″ to 6″ and 2″ to 12″ per second.

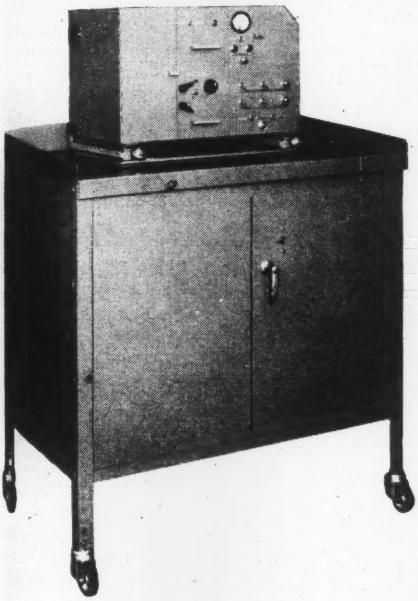
Detachable daylight loading magazine with a capacity of $3\frac{5}{8}$″ x 50′ or $3\frac{5}{8}$″ x 100′ paper. 2 to 12 individual channels.

Trace identification.

Trace viewing.

# RECORDING EQUIPMENT

## STRAIN ANALYSIS, and other Applications



## MODEL 406 OSCILLOGRAPH

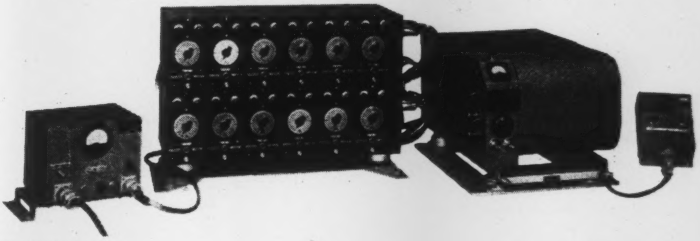
The Century Model 406 oscillograph is one of the finest laboratory instruments available. This unit will accommodate up to 48 individual channels and still incorporates all of the preferred features.

**FEATURES:**

- Size: $12\frac{1}{2}'' \times 13\frac{1}{2}'' \times 22''$.
- Weight: 90 pounds.
- Continuously variable speed control without gear change.
- Temperature compensated fork controlled timing system using a glow tube.
- Separate paper takeup magazine allowing any length of recording up to 200 ft. without jamming.
- Magazine capacity of 8" x 200' roll of paper or film.
- Separate optical system for trace viewing and scanning.
- Automatic record numbering at beginning of record.
- Paper footage indicator.
- Automatic record length control.
- Remote control unit.
- Available for 24-volt d.c. or 115 volt a.c. operation.

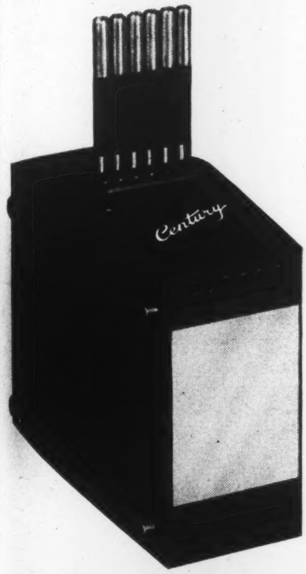
## MODEL 508 LINEAR-INTEGRATING AMPLIFIER

With Power Supply, Model 408 Oscillograph and Remote Control



**FEATURES:**

- Frequency response flat ± 5% from 3 cps to 3,000 cps or ± 2% from 5 cps to 2,000 cps.
- Frequency response linear ± 5% from 5 cps to 2,000 cps or ± 2% from 7 cps to 2,000 cps.
- Individual output metering.
- Overload indicator.



## GALVANOMETERS

All Century oscillographs are equipped with Century Model 210 galvanometer elements. These elements are available over a wide range of frequencies and sensitivities and in most instances are easily adaptable to other makes of oscillographs. Each element is electrically isolated.

**FEATURES:**

- Small, tubular type construction with rotating pole pieces flush with case. This allows correct flux angle for any horizontal position and eliminates stressing the suspension for horizontal adjustment.
- Hermetically sealed.
- Horizontal and vertical optical adjustment readily accomplished.
- Plug-in mounting, elements may be replaced or interchanged with minimum effort.
- Negligible zero drift as a function of temperature.

**Century GEOPHYSICAL CORPORATION**
TULSA, OKLAHOMA

1505 Race Street
Philadelphia, Pa.

EXPORT OFFICE:
149 Broadway, New York

# HEAD CUSTOM

DYNA-MYKE
Model 129

DYNA-METER
Model 144

UNI-BRIDGE
Model 128

## Sign of ADVANCED INDUSTRIAL INSTRUMENTATION

- Measuring
- Indicating
- Recording
- Controlling

**DYNA-MYKE Model 129**—A high speed dynamic micrometer capable of indicating displacements as small as 1 micro-inch at frequencies as high as 1000 cps. The system indicates, controls and records, using either differential transformer or strain gages.

**DYNA-METER Model 144**— When used with the DYNA-MYKE, indicates by neon lights the peak amplitude of transients as fast as 1 Millisecond. Indication may be instantaneous or a memory feature may be used to maintain reading. Built-in power relays provide on-or-off control to any plus or minus limits established by DYNA-MYKE.

**UNI-BRIDGE Model 128**—Universal DC power supply and bridge control system. Contains micro-ammeter, balancing and calibrating circuits, output jack and chopper.

**CALI-POWER AC Model 132**—A precision source of calibrated AC voltage. Provides 10 watts of power in full scales, ranges of 1 millivolt to 100 volts.

**CALI-POWER DC Model 145**—A precision source of calibrated DC voltage. Provides 10 watts of power in full scales, ranges of 10 millivolts to 100 volts. Like Model 132, AC, used for driving and calibrating amplifiers, voltmeters, resistance bridges, transducers, penmotors, galvanometers, etc.

**CALI-BRIDGE Model 134**—Combines CALI-POWER DC with the UNI-BRIDGE. A more versatile instrument for signal calibration, as well as for bridge control purposes.

**THE USE OF THESE INSTRUMENTS** can reduce manpower and eliminate causes of scrap at the source. Examples: measuring and indicating press vibration, micro-inch surface finish; indicating and controlling hydraulic or pneumatic pressure; measuring structural or metallic creep; gaging and controlling thickness of metals, plastics and fabrics.

## Applications

**LINEAR VARIABLE DIFFERENTIAL TRANSFORMERS** for minute displacements. Employed as the sensing element in the DYNA-MYKE, which is designed for use with commercially available pickups, accelerometers, transducers, etc. Fig. 1.

**STRAIN GAGES** for use with the UNI-BRIDGE, CALI-BRIDGE, and DYNA-MYKE self-contained instruments for all types of gaging and recording. Fig. 2.

**ACCELEROMETERS** for all ranges and natura frequencies, in miniature. Weight less than ½ ounce. Indicating, recording and controlling by DYNA-MYKE and DYNA-METER.

**SURFACE FINISH GAGE HEADS,** Standard and Custom Built, employing differential transformers as sensing element. Measuring, indicating, recording and controlling by DYNA-MYKE and DYNA-METER. Fig. 4.

**VIBRATION PICKUP** for direct reading of displacements as small as ±1 micro-inch at frequencies from zero to 1000 cps. Fig. 5.

**PRESSURE PICKUP** for hydraulic or pneumatic application, custom built to you specifications. Fig. 6.

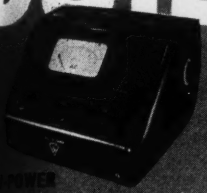
**CONTROL BOX** balancing network for use with UNI-BRIDGE, CALI-BRIDGE, or DYNA-MYKE, using either strain gages or differential transformers. Fig. 7.

**SELECTOR SWITCH** controlling as many as ten channels of measurement with one Selector Switch, ten Control Boxes, and one UNI-BRIDGE, CALI-BRIDGE or DYNA-MYKE. Fig. 8.

**SCALE** with sensitivities of one part in 10,000, using DYNA-MYKE system. Unlimited range. Fig. 9.

**AND INFALLIBLE QUALITY CONTROL** adap able to most processes. Automatic precision inspection *on the machine* with DYNA-MYKE; instant acceptance, rejection, appropriate action when teamed up with DYNA-METER.

# MBUILT INSTRUMENTS


POWER
odel 132

CALI-POWER
DC Model 145

CALI-BRIDGE · Model 134

TRANS-
s. Em-
in the
or use
ps, ac-
l.

UNI-
MYKE
pes of

atura
s than
l con-
METER

d and
trans-
uring
g by
4.

ng of
-inch
cps

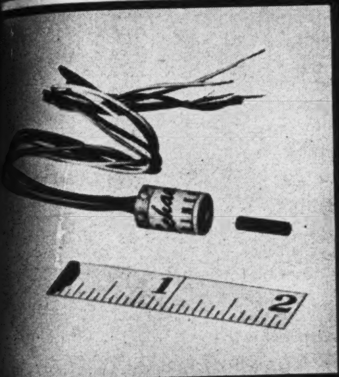
pneu-
your

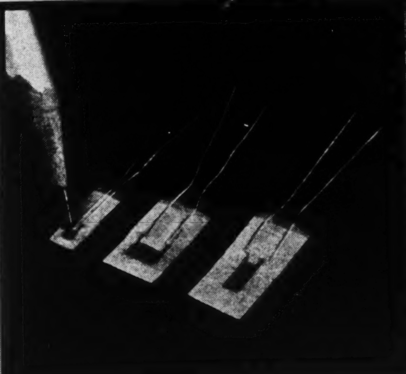
r use
NA-
dif-

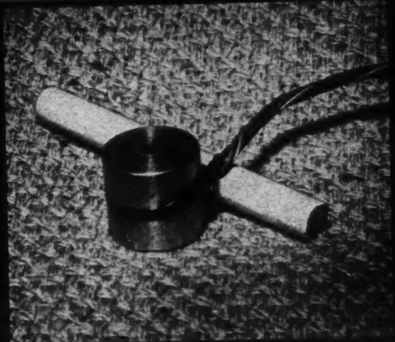
y as
one
one
YKE

in
Un-

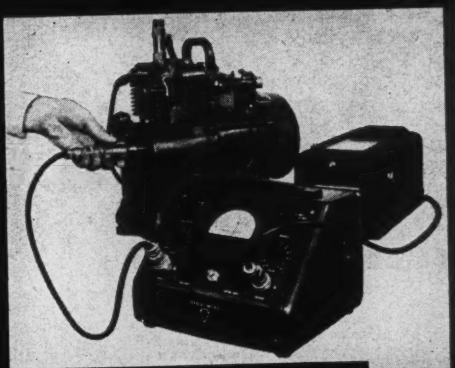
apt-
ec-
NA-
ap-
ith

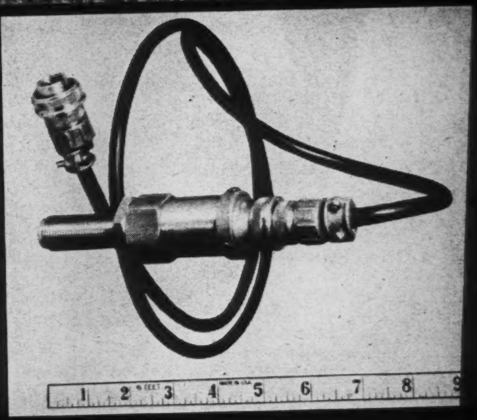

1. Linear Variable Differential Transformer


2. Strain Gages


3. Accelerometer

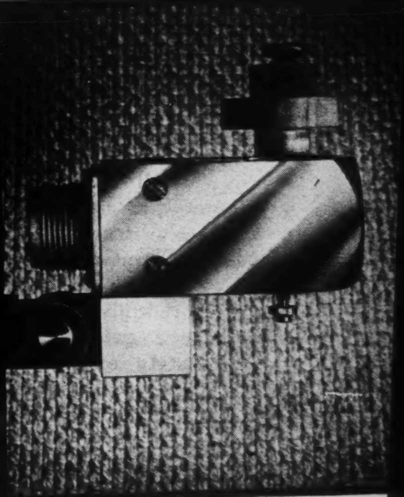
4. Surface Finish Gage Head


5. Vibration Pickup


6. Pressure Pickup

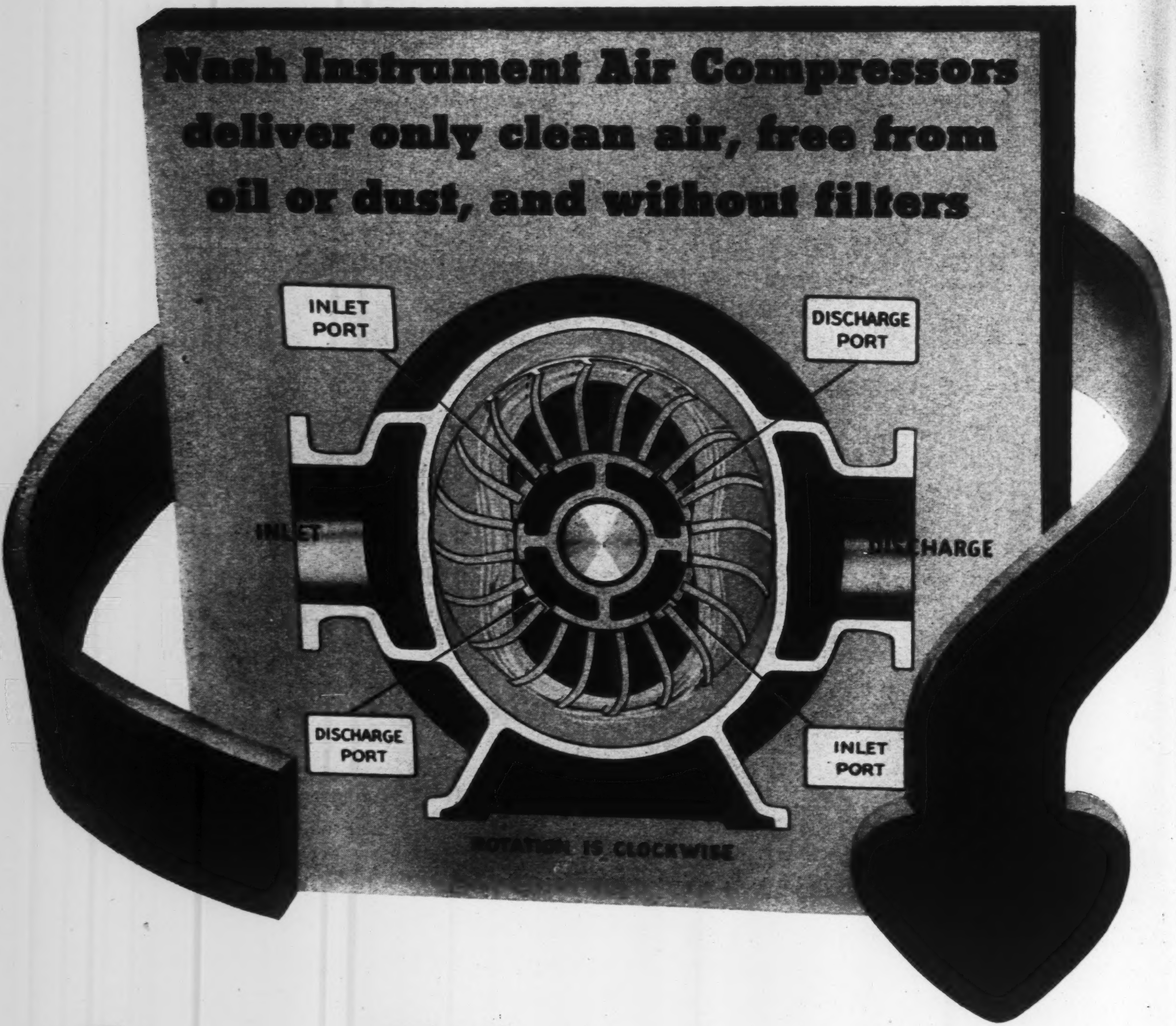
7. Control Box

8. Selector Switch


9. Scale

NDUSTRIAL ELECTRONICS, INCORPORATED

8082 WHEELER STREET • DETROIT 10, MICHIGAN


Nash Instrument Air Compressors deliver only clean air, free from oil or dust, and without filters
INLET PORT
DISCHARGE PORT
INLET
DISCHARGE
DISCHARGE PORT
INLET PORT
ROTATION IS CLOCKWISE

# *Here is Why!*

You can dispense with oil filters and dust filters when you install ®Nash® Clean Air Compressors. You can save the cost of maintaining these devices. You can greatly reduce instrument maintenance costs. For the Nash employs no internal lubrication, therefore no troublesome oil is in the delivered air. Moreover, air from a Nash is thoroughly washed and cooled as it passes thru the pump. Dust in the plant atmosphere, even fly ash, is immediately removed.

®Nash® Clean Air Compressors are simple, with only one moving element. No valves, gears, pistons, sliding vanes, or other enemies of long life and constant performance complicate a Nash. No aftercoolers are needed. You will find it profitable to investigate these pumps, now.

**No oil filters.**
**No dust filters.**
**No internal lubrication to contaminate air handled.**
**No internal wearing parts.**
**No valves, pistons, or vanes.**
**Non-pulsating pressure.**
**Original performance constant over a long pump life.**
**Low maintenance cost.**

**NASH ENGINEERING COMPANY**
**370 WILSON, SO. NORWALK, CONN.**

# MEASUREMENT AND CONTROL DEVICES FOR

## Gases • Oil • Steam • Air • Liquids

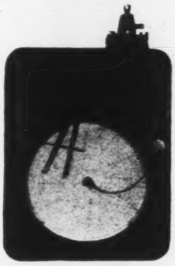
Trade Names: AMERICAN • RELIANCE

AMERICAN METER CO MEASUREMENT ENGINEERS

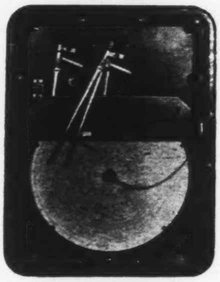
PRODUCTS Meters: Demand, Displacement (Gas or Air), Flowmeters, Indicating, Integrating, Recording, Laboratory, Orifice, Oxygen, Prepayment, Wet and Dry Test, Wide Range Orifice, etc. INDEXES: Base Pressure, Base Volume, Demonstration, etc. CONTROLLERS: Flow, Liquid Level, Pressure, Rate and Volume, Remote Control. GAGES: Differential, Volume and Pressure. REGULATORS: Automatic Gas Cut-Off, Back Pressure, Balanced Valve, Bottled Gas, Gas and Air Pressure, High Pressure, etc. LABORATORY GAS TESTING APPARATUS: Calorimeters, Sulphur and Ammonia Test apparatus, Hydrogen Sulphide Test equipment, 1-10 Cubic Foot Bottles, Wet Test Meters, Dry Governors, Wet Governors, Specific Gravity Apparatus, Recording Gravitometers, etc.

### ORIFICE METERS

**Indicating—Recording—Integrating**



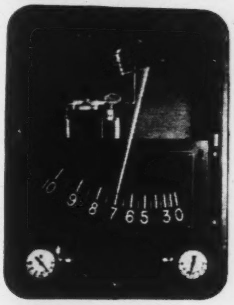
Thousands of American Meter Company's Orifice Meters based on the famous Westcott Manometer are making year-in-year-out records of sustained accuracy in the petroleum producing and refining fields. Complete engineering installation data is included in current bulletins on Recording and Integrating Orifice Meters.



THE DOUBLE INTEGRATING ORIFICE METER gives a totalized reading of the quantity which has passed through the orifice for all flow rates and all pressure variations. It integrates for static pressure as well as for differential.

THE SINGLE INTEGRATING ORIFICE METER charts a totalized reading of the quantity of gas or steam at constant pressure—or for liquids, regardless of the rate.

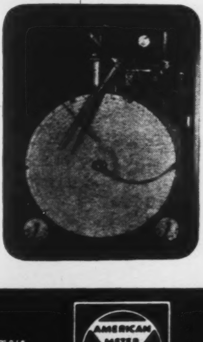
### SERIES A-88 PNEUMATIC TRANSMITTER AND CONTROLLER



Many maintenance and servicing problems are answered by the Series A-88 pneumatic Transmitter and Controller operating on standard 3-15 psi air pressure range.

In addition to a high degree of interchangeability of parts and sub-assemblies, the following important features are included:

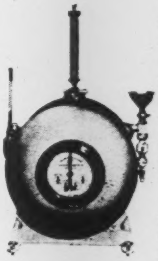
1. NO NEED TO BREAK TUBING CONNECTION for nozzle adjustment.
2. INSTRUMENT CAN BE REVERSED by shifting one link without disturbing other adjustments.
3. LINKAGE ALIGNMENT MADE EASY IN FIELD with positioning device.
4. MAXIMUM PROPORTIONAL BAND CHANGES with minimum output pressure changes.
5. EASY POSITIONING OF NOZZLE permits widening of proportional band without disconnecting tubing, or disturbing other adjustments.
6. DAMPENING DEVICE IN RELAY insures smooth operation.
7. EASY POSITIONING OF LINKAGE MECHANISM by means of housed proportioning bellows incorporating knurled wheel (with locking device).
8. LINEAR ADJUSTMENT between transmitter and receiver.



### DRY TEST METERS

The operating mechanism of dry test meters is actuated by diaphragms. The meters are used to measure gas unsaturated with water vapor and are designed to meet the requirements of industries using such diversified gases as air, natural and manufactured gas, butane, propane, high gasoline content gases, hydrogen, oxygen, and acetylene, either dry or moist.

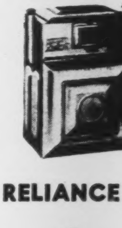
### WET TEST METERS



In laboratory testing of gases every detail of American wet test meters from gage glass to water line marker and chromium plated pointer insures not only more precise reading . . . quickly . . . but insures continued accuracy of operation for many years.

### DISPLACEMENT METERS

The complete Ironcase line ranges from the small, low-pressure 5-B type to high pressure meters of maximum capacity.



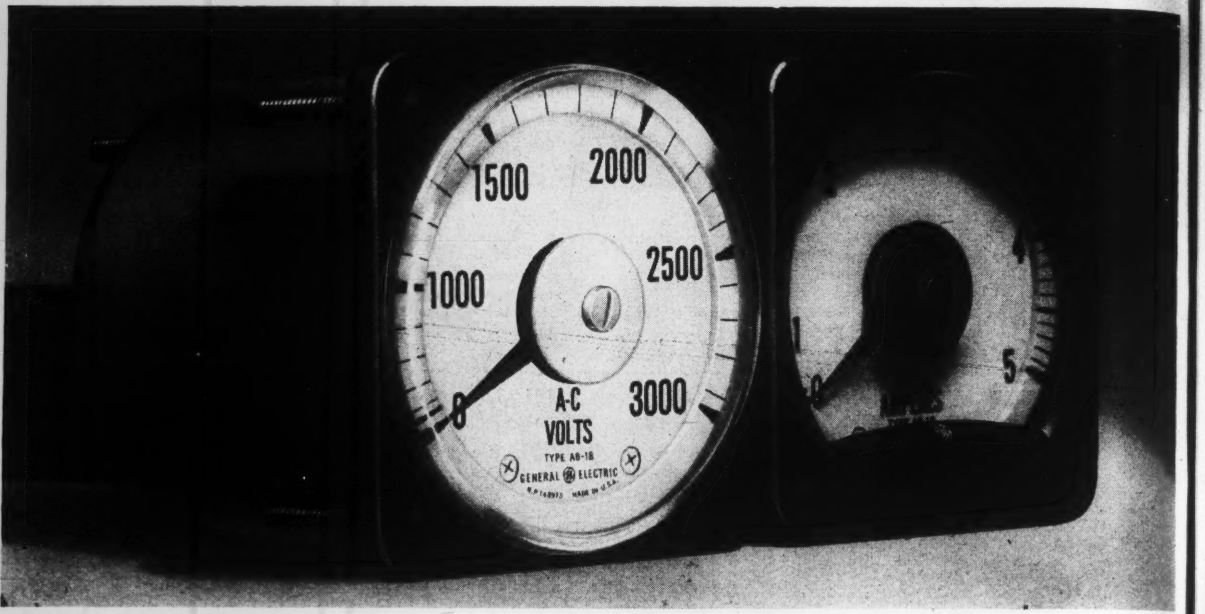
### RELIANCE GAS REGULATORS

A complete line of high and low pressure types and wide range of models. Close control. Minimum pressure loss, ease of servicing and low cost of upkeep.

GENERAL SALES OFFICE 1513 Race St., Philadelphia
Albany • Alhambra • Amarillo • Atlanta • Baltimore
Birmingham • Boston • Chicago • Dallas • Denver • Erie
Houston • Kansas City • Los Angeles • New York • Odessa
Pittsburgh • San Francisco • Tulsa • Hamilton Ontario

AMERICAN METER CO MEASUREMENT ENGINEERS

# AMERICAN METER COMPANY



Both instruments are lighted from above. Note how much easier you can read the new dial

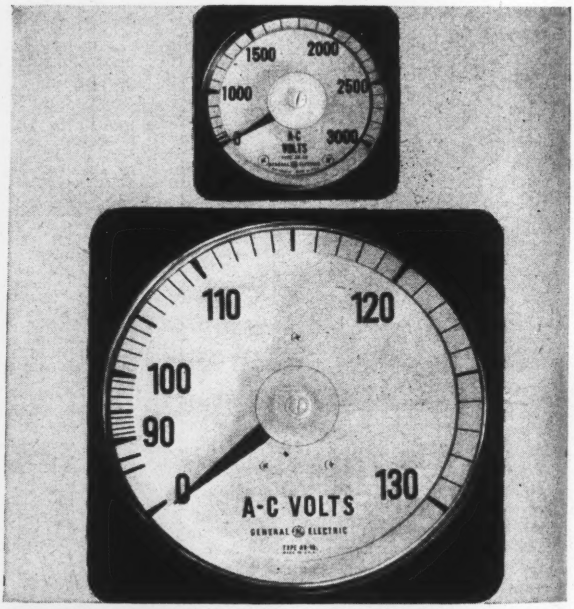
# COMPARE THE READABILITY!

## Shadow-proof dial makes new G-E instrument easier to read

Two new lines of switchboard instruments—4¼- and 8¾-inch sizes—have just been introduced by General Electric. Here are new instruments you can *read*—always. No more shadows caused by overhead lighting. No more cover overhang. The dial is set forward, flush with the front of the case, and a protruding convex-type glass front provides clear illumination from any angle. Anti-glare glass prevents reflections. Even when the lighting angle is sharp, you can easily read these instruments.

You can obtain shadow-proof instruments in both sizes as ammeters, voltmeters and wattmeters; frequency and power-factor meters; temperature indicators and synchroscopes.

Specify General Electric shadow-proof instruments for control stations, testing devices and other installations. Ask your G-E representative today for more information or write for bulletin GEC-218B, General Electric Co., Schenectady 5, N. Y.



**AVAILABLE IN TWO SIZES.** Type AB, DB-18 is 4¼ in. square, 250-degree scale, 7.1 inches long. Type AB, DB-16 is 8¾ inches square, 250-degree scale, 14.2 inches long. Both have 1% accuracy.

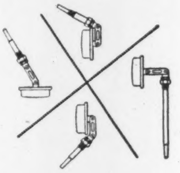
**GENERAL ELECTRIC**

602-191C

# PALMER THERMOMETERS are accurate—very accurate

## PALMER Dial THERMOMETER

Adaptable and interchangeable with all Industrial Thermometer applications. MERCURY-ACTUATED. Guaranteed accuracy. Size: 4½" Dial.

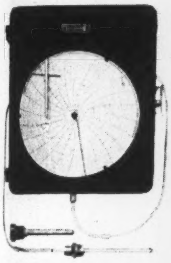


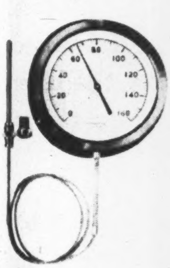
Designed for use as STRAIGHT or any ANGLE. With clear vision all-glass moulded case and metal back. Fittings: Plain, Union, Socket; adjustable or union Flanges.

STANDARD RANGES:

—40+100°F.1°
0+150°F.1°
0+240°F.2°
0+300°F.2°
0+400°F.5°
0+500°F.5°
0+600°F.5°
+200+750°F.5°
+200+900°F.5°
0+110°C.1°
0+150°C.1°
0+240°C.2°
0+300°C.2°

(Write for NEW Bulletin No. 128)





## RECORDING and DIAL THERMOMETERS

**With Flexible Tubing Connection.**

Mercury-actuated, for extreme accuracy. Sturdy construction, very sensitive. All parts rust-proof. Stainless-steel bulb. Wall or Flush Mounting. Bottom or Back connection. Fittings: Plain, Union, Sep. socket; Adj. or Union Flanges. Ranges: —40 to 1000° F. (or C).

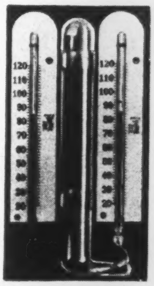
**RECORDER:** 12" die-cast alum. case; Black or white, satin or wrinkle finish; elec. or spring clock; 12 hr., 24 hr., or 7-day charts. One-pen or multiple pens. Also Fully compensated to correct for Ambient Temperature.

**DIAL:** 6" and 8" round case. Black or white finish. Easy-reading dial.

**(Write for 1951 edition #200-G Catalog)**

## PSYCHROMETER and HYGROMETERS

For testing humidity. Chart furnished. Wet and Dry bulb with "Red-Reading-Mercury" lens tube for easy reading. Sling Psychrometer—in metal case. Wall Hygrometer—with water reservoir. +30+110°F. +80+220°F.



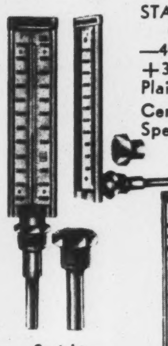
## INDUSTRIAL THERMOMETERS with "Red-Reading-Mercury"

CASE: 7", 9" or 12" Extruded brass. Wide scale. Chrome finish.
TUBE: Red Reading Mercury Easy to Read. Thoroughly annealed for permanent accuracy. Protected by double-strength glass shield. Graduated scale.
FITTINGS: Fixed thrd., Union, Sep. Socket; adjustable or union Flange; parallel thrd. & locknut; special fttgs. to order.
STEM: STRAIGHT and Misc. ANGLES. 3½" to 60", incl. thread.
THREAD: ¾" or 1" NPT. (½" not recom.)

STANDARD RANGES:

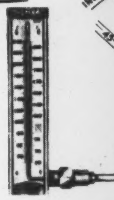
0+100°F.
—40+110°F.
+30+180°F.
+30+240°F.
+170+270°F. &P.
+150+350°F. &P.
+30+300°F.
+50+400°F.
+100+500°F.
+200+750°F.
Plain Mercury. Borosilicate tube. +200+950°F.

Centigrade equiv.—no extra.
Spec. Ranges—cost more.

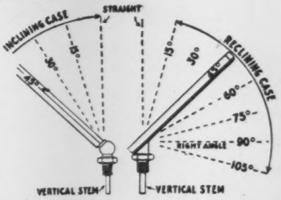


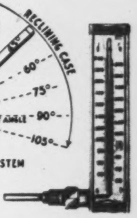
Angle

Straight

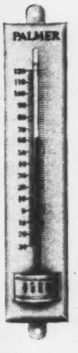


Right Side





Left Side

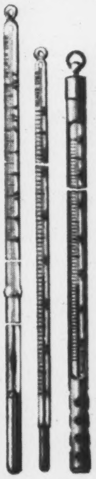


## SMALL CASE THERMOMETERS

4" case: ⅜" & ½" Fixed Thrd. Fttg.
6" case: ½" & ¾" Sep. Socket Fttg.
Extruded case. Durable Nickel finish.
"Read-Reading-Mercury". Guaranteed accurate.

## WALL THERMOMETERS

Indoor or outdoor. Very accurate. 12" copper case, with removable Tube and scale. 10" metal scale, with hangers top & bottom. All with lens mercury tube, showing wide RED column.



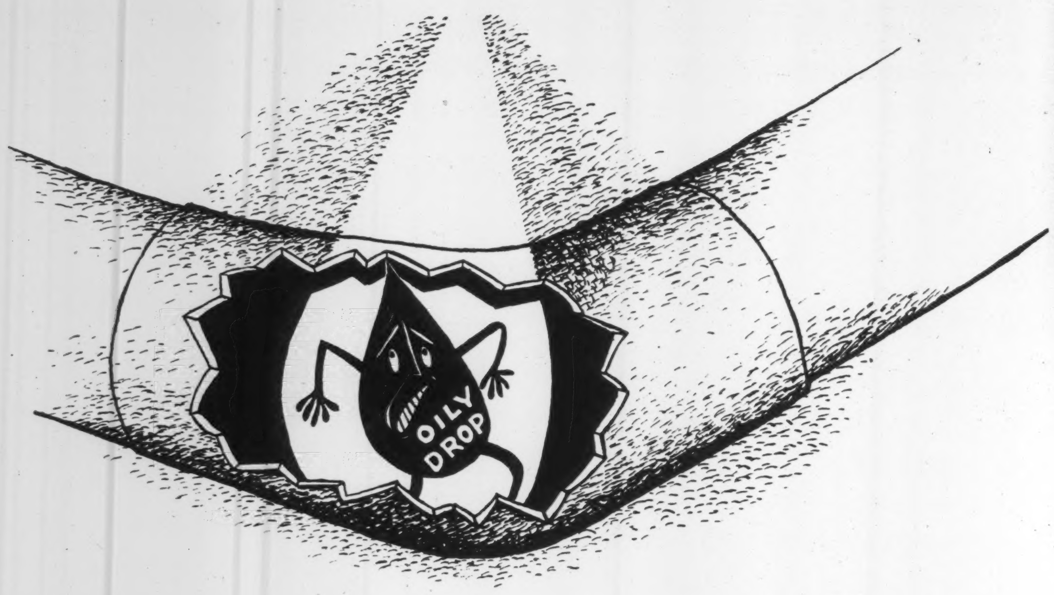
## LABORATORY AND PRECISION THERMOMETERS

All glass engraved mercury tube, with vivid RED column. Round or lens; Ring or button top; With or without metal armor; Total or partial Immersion (3" standard). Each in sep. box. All ranges: up to 750° F. (or C. equiv). Plain mercury. Borosilicate tube. +200+950°F. Special ranges & dimensions to order. Fractional division, A.S.T.M. etc.

Also handy 5" Pocket style. Annealed and guaranteed very accurate.

**REPAIRS**—To all makes of mercury Industrial Thermometers. With "Red-Reading-Mercury" (no extra cost) and new Extruded Brass case included. Guaranteed accurate. Reasonable price.

**PALMER THERMOMETERS, INC.**
*Mfrs. of Industrial Laboratory, Recording and Dial Thermometers*
**2518 NORWOOD AVE., CINCINNATI 12, O.**
CANADIAN PLANT: PALMER THERMOMETER LTD., TORONTO, 2

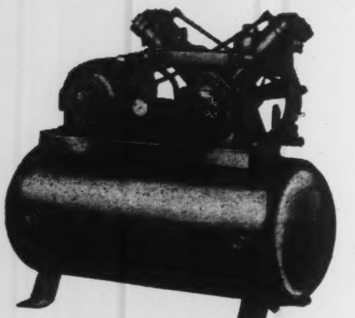


# *spotlighting a different kind of saboteur in vital instrument lines!*

Oil-laden air can knock out your air-operated instruments . . . just as effectively as a "fifth columnist" can! When a slug of oil hits, you know what it can mean in production losses and excessive maintenance. That's why you'll be interested in this news about an easy, economical way to eliminate oil in instrument lines:

Ingersoll-Rand has engineered special air compressors that deliver *oil-free* air. These I-R Compressors feature pistons fitted with patented, graphitic carbon rings. The rings prevent metallic contact of the piston with the cylinder bore. The carbon rings are segmental with metallic inner expanding rings to give the proper wall pressure. Because metallic contact is eliminated, and the rings are self-lubricating, the Ingersoll-Rand NL Compressor cylinders require no lubricant.

If oil-laden air has *ever* caused you trouble, Ingersoll-Rand has engineering facts and figures that will interest you. Just contact your nearest I-R representative, or write direct to Ingersoll-Rand, 11 Broadway, New York 4, New York.



**Model N machines available through 1 hp.**
**Model 235 HNL machines available through 3 hp—other models through 250 hp.**

**Ingersoll-Rand**

***NL COMPRESSORS***

...70 years of compressor "know-how" packed into these new compressors for air operated instruments!

# Quick Check List

## OF INSTRUMENTS BY FOXBORO
Reg. U. S. Pat. Off.

### INDICATORS • RECORDERS • CONTROLLERS

- **Air Weight**
- ***Conductivity**
- ***Consistency**
- **Density (Specific Gravity)**
  - differential pressure type
- **Flow**
  - mercury-manometer type
  - "d/p Cell", force-balance transmitter type
  - float-and-cable type
- **Humidity**
  - wet-and-dry-bulb temperature
  - relative humidity (hygroscopic type)
  - absolute humidity and dew point temperature ("Dewcel")
- **Liquid Level or Interface (in open or pressured vessels)**
  - diaphragm type
  - bubble tube (purge) type
  - differential pressure type
- ***Load, Force, and Torque**
- ***Moisture Content (sheeted materials)**
- **Motion and Position Recorders**
- ***Motor Load (Power)**
- **Operation Time Recorders**
- ***pH (with Beckman glass electrodes)**
- **Pressure, Absolute Pressure, and Vacuum**
  - spring and hydron types
  - differential type
  - *electric pressure cell types
- ***Resistance (Electric)**
- ***Speed (R.P.M. or Lineal)**
- **Temperature**
  - filled-system types
  - resistance bulb ("Dynalog" electronic and galvanometer types)
  - thermocouple ("Dynalog" electronic and galvanometer types)
- ***Tension**
- ***Thickness (sheeted materials)**
- ***Viscosity**
- ***Voltage, Current, Impedance, Dielectric**
- ***Weight (sheeted materials in process)**
- ***Weight and Force (strain gauge type)**

### CONTROLLER TYPES

**Pneumatic**

Model 40: On-Off
Proportional
Proportional with Derivative
Proportional with Reset ("Stabilog")
Proportional with Reset and Derivative ("Hyper-Reset")
Consotrol (Console/Graphic Panel Types): in all above control mechanisms except on-off
Model 41: On-Off and Proportional
Round Case: On-Off and Proportional

**Electric**

Rotax (rotary contact type)
On-Off
Multi-Position
Galvanometer Type
On-Off
2- and 3-position
Proportioning

### CONTROL SYSTEMS

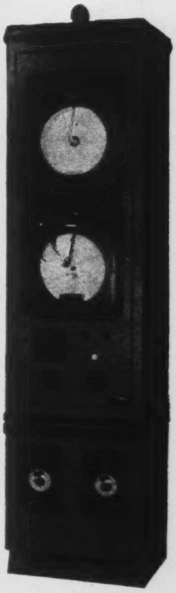
Auto-Selector
Averaging
Dual
Duplex
Limit
Ratio
Relation
Sequence
Time Schedule (cam and camless types)

*with Dynalog Electronic Instruments

## COMPLETE AUTOMATIC CONTROL UNITS

Any combination of Foxboro instruments required for precise control of an industrial process now is available in a complete pre-engineered cabinet assembly. Foxboro Automatic Control Units come fully assembled. All instrumentation is expertly connected and coordinated at the factory. Installation of complete control system requires only simple external connections of air and power supply, and primary measuring elements.

Shown at the right is a typical Foxboro Cabinet type Integrated Process Control System. Other combinations of standard units incorporate any required number of recording and controlling instruments plus gauges and other supplementary equipment.

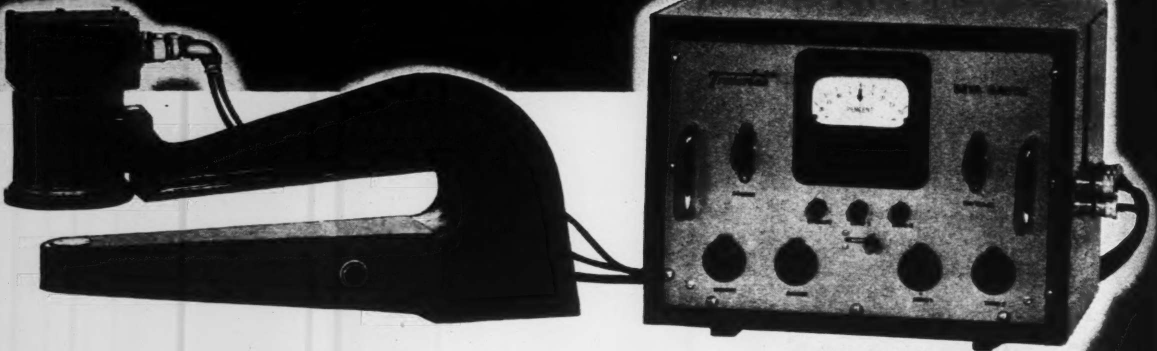


THE FOXBORO COMPANY, 4613 Neponset Ave., Foxboro, Mass., U.S.A.

# THICKNESS CONTROL A PROBLEM?

## *Tracerlab Beta Gauges*

## CUT COSTS—IMPROVE QUALITY



TRACERLAB's new model, non-contacting Beta Gauge measures and records the weight per unit area or thickness of sheet materials. Because beta radiation is used, a high degree of accuracy and sensitivity is achieved, unaffected by variations in chemical composition of the material being gauged.

Tracerlab developed the first Beta Gauges, and the experience gained through having these instruments in successful, everyday operation in a number of diversified process industries has now been incorporated in a new and outstanding gauge. Featured are simplicity of operation, ruggedness of design and reliability of operation — all combined in an instrument that maintains Tracerlab's established leadership.

The gauge's low cost will be rapidly repaid from raw material savings resulting from closer manufacturing tolerances and faster control, plus a greater uniformity of product with its resulting advantages. A meter showing percentage variation from normal, or a meter calibrated directly in weight or thickness, is standard equipment. Where a continuous record is desired, various types of recorders are available.

For non-contacting gauging of materials accessible only from one side, Tracerlab manufactures a model which operates by measuring "back scattered" beta particles. This gauge is particularly useful in gauging rubber, paper, plastics and other materials as they pass over a calender roll. It has also proved highly effective in measuring thickness of coatings on certain substances.

*For complete information, write for Bulletin BG-RI.*

*Tracerlab*
**BETA GAUGES**
**are NOW gauging:**

CARDBOARD
•
PLASTICS
•
PAPER
•
ADHESIVE TAPE
•
SHEET METAL
•
RUBBER
•
PAPER COATINGS
•
METAL FOIL
•
PLASTIC COATINGS
•
PHOTOGRAPHIC COATINGS
•
LINOLEUM

***SALES OFFICES:***
**BERKELEY, CAL., CHICAGO, ILL.**
**NEW YORK, N. Y.**
**WASHINGTON, D. C.**

*Tracerlab*

**TRACERLAB INC., 130 HIGH STREET, BOSTON 10, MASS.**

# INSTRUMENT PANELBOARDS by FALSTROM

**Falstrom-Built Means Built by Experts!** FALSTROM engineers in the field continually exchange ideas with leading instrument men to see what new designs or construction features FALSTROM can recommend which will make a more efficient and economical panel for mechanical or electrical equipment. Many of their meetings have resulted in the introduction of standards now accepted 'round the world — wherever instrument boards serve.

**What Does Your Problem Deal With?** Housing, casings, enclosures, switchboards, gageboards, turbine or boilerboards, mechanical or electrical panels, complete control centers, benchboards, pumpboards, meterboards, double-faced cubicles, outdoor type cubicles—? Send us your blueprints for quotations and ask about our standard designs.

**Metal Fabricating Division** In addition to its Panelboard Division, FALSTROM has excellent facilities for custom metal fabrication. For contract manufacturing at practical unit costs, send your blueprints for pricing to FALSTROM COMPANY, Metal Fabricating Division, 90 Falstrom Court, Passaic, N. J.

**Send for Literature** Your request will get these informative, illustrated bulletins; Modern Design for Instrument Panels and Cubicles, Instrument Panelboards by FALSTROM, Steel Products for all Purposes, or Equipment Appearance — Re-Design. See our monthly advertisements next to Table of Contents in "Instruments".

## STANDARD PANELS BY FALSTROM

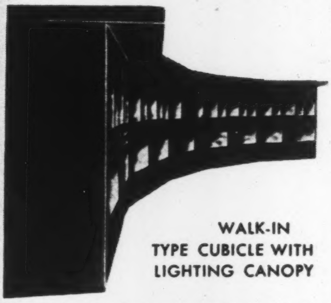
The economical solution to many steel panel requirements. They are designed in several sizes and thicknesses and are equipped with standard accessories. Falstrom Standard Steel Panels are designed for use singly or in groups to accommodate practically all types of installation. These panels are not stock items — but standard dies speed delivery.

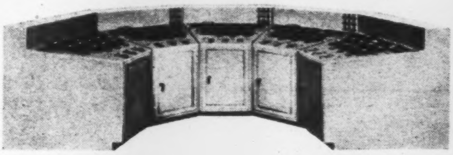
## FALSTROM CONSOLE CABINETS

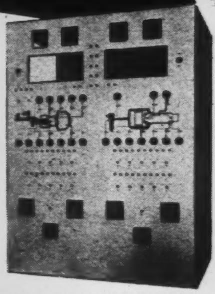
The designing, engineering and fabricating divisions of FALSTROM are equipped to produce any size or style of instrument board to specification. Features such as lighting canopies, graphic panels, access doors, color finishes, air filters, blowers or exhausters and other special equipment can be built-in during production.

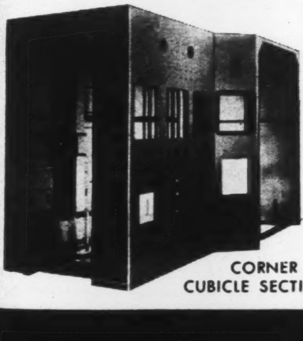
## FALSTROM-BUILT CUBICLES

The fully enclosed self-supporting instrument or control housing has several very important advantages. Added protection is provided against damage, dust and tampering. This type structure is now in wide use in industry. Falstrom engineers welcome the challenge to meet your specific applications.


WALK-IN TYPE CUBICLE WITH LIGHTING CANOPY


BENCHBOARD CONSOLE


GRAPHIC SELF- SUPPORTING PANEL


CORNER CUBICLE SECTION

STREAMLINED CABINETS

MONITOR DESK CONTROL BOARD

FABRICATORS OF METAL
PRODUCTS FOR INDUSTRY
SINCE 1870

—for all PANELBOARD requirements specify—

**FALSTROM COMPANY**

90 FALSTROM COURT, PASSAIC, NEW JERSEY

**Fenwal**

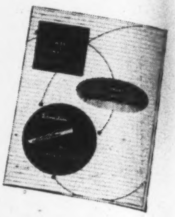
# THERMOSWITCH®

## Precision, Multi-Purpose Thermostat Controls

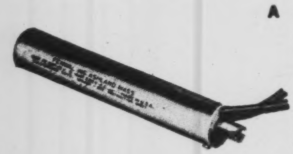
SENSITIVE . . . *but only to heat*

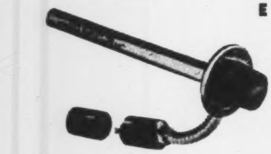
In a THERMOSWITCH thermostat the activating element is the *single-metal* temperature-sensitive shell which, in direct contact with the ambient temperature to be controlled, expands *without lag,* causing the contacts inside to open. Completely enclosed against dust. Shock and vibration proof, the THERMOSWITCH control also provides high load-carrying capacity, wide adjustment range and ease of installation. No other thermostat on the market today offers you so many assurances of positive, accurate temperature control, long service life and operating economy.

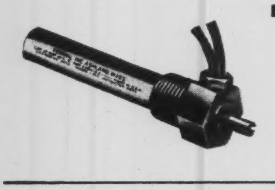
SEND FOR FREE BOOKLET containing further details on unique THERMOSWITCH thermostat. Write Fenwal, Incorporated, 170 Pleasant St., Ashland, Mass., 111 South Burlington Ave., Los Angeles 4, Cal.

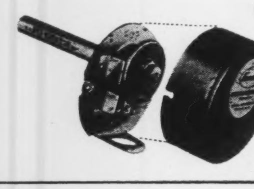


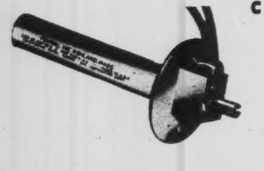
## Which of these THERMOSWITCH types fits your requirements?

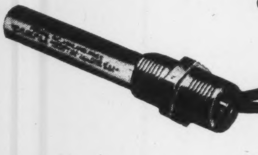

A

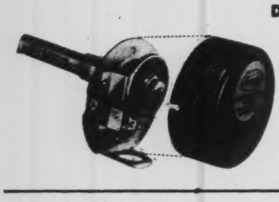

E

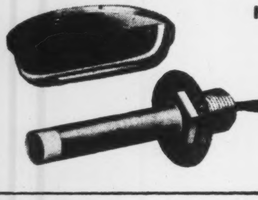

B


F


C


G


D


H

**CARTRIDGE TYPE**

**A.** This compact, small-sized, self-contained unit is the basis for most THERMOSWITCH models. For temperatures ranging from —100F to +400F (or +100F to +600F). Higher ranges also furnished.

**HEX HEAD**

**B.** Furnished with ½" (or ¾") standard pipe thread for mounting in tapped hole or suitable boss.

**FLANGE HEAD**

**C.** Has flange 1¾" in diameter with three tapped holes for mounting on any flat surface.

**JUNCTION BOX — IMMERSION**

**D.** Has conduit junction box attached. Threaded hexagon section permits immersion of brass shell in fluid through tapped hole or boss. Cover houses terminal block, dial and knob. Special units available with Underwriters' Listing.

**ALL-PURPOSE**

**E.** Comes with extended nickel-plated shell, dial, knob and midget plug connector for experimental or general laboratory work.

**JUNCTION BOX — AIR**

**F.** Has an electric conduit junction box attached to the extended shell of a basic cartridge unit. For air ducts, ovens, driers, etc.

**COUPLING HEAD**

**G.** Has ½" or ¾" standard male pipe threads at each end of its hexagon mounting section. Simplifies attaching to conduits and explosion-proof fittings.

**DETECT-A-FIRE**

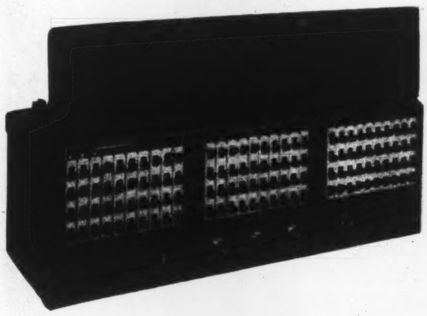
**H.** Unique new Rate-Compensation principle of fire detection does away with time lag, false alarms. Unit responds only when temperature of surrounding air reaches predetermined danger level. (1) Horizontal model Series 70 for commercial, industrial and public buildings, institutions and ships in locations electrically classified as "ordinary." (2) Explosion-proof vertical model Series 71 listed and approved for locations electrically classified as "hazardous" . . . i.e., Class I, Groups C and D; Class II, Groups E, F, and G . . . as well as "ordinary" locations. Both models listed by (UL). Approved by ⟨FM⟩.

**FENWAL INCORPORATED Ashland, Massachusetts**

# DO IT WITH PUSHBUTTONS!

## WHY USE "HORSE AND BUGGY CONTROLS"—"IN A JET AGE?"

**CASE TYPE**

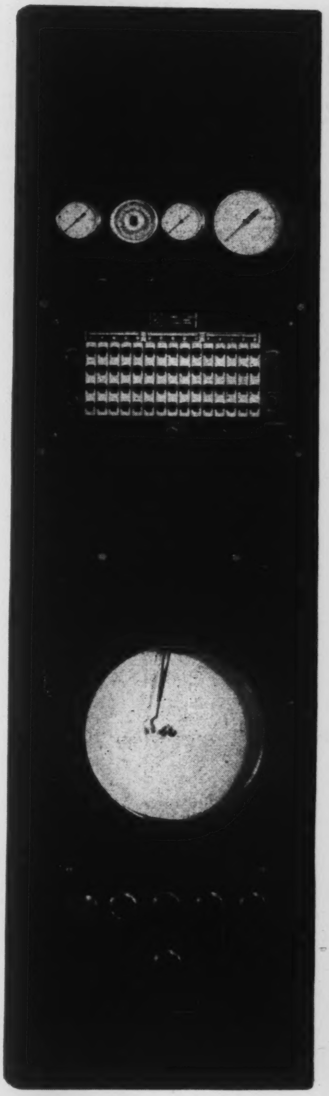


**SET UP IN SECONDS**
**NO CAMS! NO GEARS**
**NO DRY RUNS**
**NO ADJUSTMENTS**

**Graphic type pushbutton panels permit instant cycle changing by the mere flick of a button! No longer is automatic control impractical due to short runs and varied cycle requirements.**

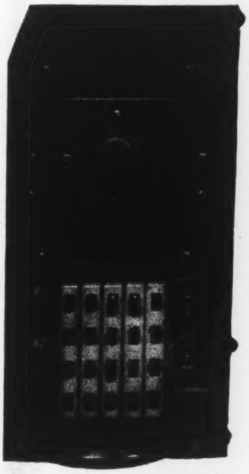
Complex sequences are no longer difficult to obtain. The ROBOTRON pushbutton cycle controller has been designed to make set-ups easy for even non-technical supervision. Fully electrical, without electronic tubes or delicate components, the ROBOTRON design has been reduced to only one moving part other than the motor, and wear has been eliminated as a control problem. As there are no adjustments, another major maintenance problem, that of keeping equipment adjusted, has been removed.

**PANEL TYPE**



*ROBOTRON CONTROLS, tuned to this Jet Age, spearhead the present drive against waste, inefficiency, and lost production. They lead in raising standards of quality and increasing productivity of present equipment.*

**CABINET TYPE**



- **SIMPLICITY**
- **DEPENDABILITY**
- **EASE OF SET-UP**
- **FLEXIBILITY**
- **TROUBLE-FREE SERVICE**

Available in many models, from the simple to the very complex, ROBOTRONS also are custom-designed in various case types. Panel mount types adapt to modern installations and are suitable for including as original equipment on hydraulic presses or other machinery. Case types are suitable for average requirements, and the cabinet types permit grouping in control centers away from the dirt and abuse of the press room. Long, dependable, wear free and positive control will prove the economy and value of ROBOTRONS.

*Additional data can be sent upon receipt of a statement of your control sequence.*

**Catalog showing Complete line upon request.**

OTHER *Products of* **MERIT** INCLUDE

3000 LB. - 5000 LB. HYDRAULIC DIAPHRAGM VALVES - 300 LB. - 500 LB. DIAPHRAGM VALVES
TEMPERATURE CONTROLLERS - PRESSURE CONTROLLERS - CERAMIC VALVES

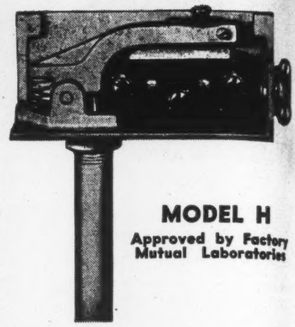
## EMMETT MACHINE & MANUFACTURING, INC.

2249 FOURTEENTH ST., S. W.    AKRON 14, OHIO    PHONE SH-3101

# BURLING TEMPERATURE CONTROLS

Improved High Temperature Safety Switch. Available with switch normally closed for cutting off heat, stopping fan, closing valve—with switch normally open for lighting lamp or ringing bell—with single pole double throw switch . . . breaks heating circuit while closing alarm circuit.

• Accurate, Rugged, Dependable. • Corrosion and heat resisting tube. • Dial Pointer for easy setting inside case. • Locking screw locks temperature setting. • Terminal plate has large screw terminals. • Snap-action Micro-Switch eliminates contact troubles. • Range minus 100° to 1400°F. Adjustable range 200. • Dimensions —5⅛" x 1¾" x 3".

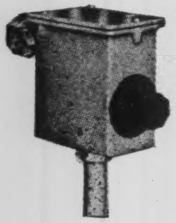


## MODEL H

Approved by Factory Mutual Laboratories

## MODEL "Y"

### Temperature Controlled Valve



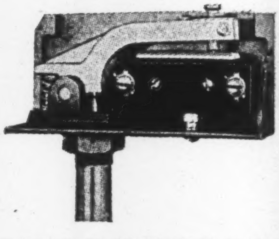
For controlling temperature of equipment by controlling flow of fuel, controlling temperature of equipment by controlling flow of cooling medium, high or low temperature safety cut off, high or low temperature safety cut off for air operated valves.

Temperature range from minus 300° F. to plus 1800° F. Readily interchangeable bronze spring-closing valve with removable discs for air, water, gas, oil, steam, or gasoline. Sizes ¼", ⅜", ½", and ¾". No back lash or lost motion in movement of valve. Available with temperature setting inside (Model Y) with temperature setting outside (Model YD) Available for closing valve on rise in temp. (Models Y & YD) for opening valve on rise in temp. (Models YR & YRD)

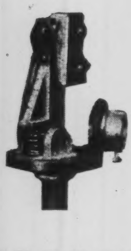
## MODEL H

### With Manual Reset Button

Available with switch normally closed for cutting off heat, stopping fan, closing valve—with switch normally open for lighting lamp or ringing bell —with single pole double throw switch that breaks heating circuit while closing alarm circuit. Sturdy, foolproof reset button operates from outside case. Range 0-1400° F; adjustable range 200-250° F. Dimensions: 5½" x 1¾" x 3". Dial pointer for easy setting.



## MODEL V-1

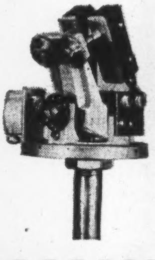


Designed for the lower temperature range from 0-300° F. Model V-1 is also available for minimum of −100° to maximum 600° F. Usual adjustable range is 50-150° and operating differential may be as small as ±¼° or as large as ±5°. Adjusting screw and dial are inside of case. Dimensions: 2¾" dia. x 4¼" high.

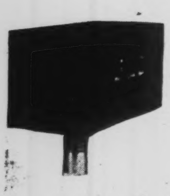
EXPLOSION PROOF HOUSINGS—Models V-1 and VD-2 can be mounted in explosion proof housings. When so mounted V-1 can be furnished for any temperatures from minus 100° to 1400° or 1600°. Model VD-2 can be furnished with the temperature adjustment either inside or outside the case.

## MODEL VD-2

Contains 2 snap-action Micro-Switches which may be any two of the following types: Normally open, normally closed, single pole double throw switch. The switches are mounted on a moving lever and both switch lever and adjusting lever rotate about a common axis. Each switch has an individual adjusting screw and locking disc, thus making it possible to adjust the differential between switches from very close limits to a maximum of 150-200° F. The main temperature can be changed without changing differential between switches. Main adjusting screw is usually outside but may be had inside upon request. Suitable for temperatures up to 1200° F. Adjustable range 300-600° F. Size 3½" dia. x 4⅝" high.



## MODEL D

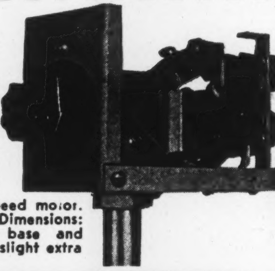


Same general characteristics as Model H but for use where temperatures must be changed to suit operating conditions. Turn outside knob to change temperature setting. Simple in design . . . accurate and dependable under severest operating conditions. Temperature range 0-1400° F. Standard adjustable range 200°-500° F. Dimensions 5½" x 2¾" x 2¾".

## MODEL E

**only 1 light-weight moving part. Available with 1, 2 or 3 switches.**

As a 3 switch model, Burling Model E is recommended for use (a) where load is divided into 3 parts (b) where 1 switch is used for controlling, one as a high limit, one as a low limit, (c) to give definite stops or position to a 3 or 4 position diaphragm motor, (d) to give 3 speed control of variable speed motor. Adjustable range to 700-1000°. Dimensions: 7¼"x2¾"x3½". Vapor tight base and cover with gasket available at slight extra charge.



Over 12 years specialization in the design and manufacture of precision temperature controls stand behind every Burling Instrument. This broad experience makes it possible for Burling to solve even the most specialized problems in this field.

The Burling engineering department is ready to work with your engineers on all types of temperature control problems. Our broad experience with situations involving high pressures, corrosion, average temperature across a duct, explosion-proof housings, etc. is at your disposal. Among the many satisfied Burling customers are such nationally known concerns as:

- Aluminum Company of America
- Aluminum Company of Canada
- American Type Founders, Inc.
- Anaconda Wire & Cable Co.
- Jabez Burns & Sons
- Detroit Aluminum & Brass Corporation
- E. I. du Pont de Nemours & Company, Inc.
- Eagle Pitcher Lead Company
- Eastman Kodak Company
- Walter Kidde Company
- Lydon Brothers
- Morrison Engineering Company
- J. O. Ross Engineering Corporation
- Standard Oil Company of New Jersey
- Sta-Warm Electric Company
- Swindell-Dressler Corporation
- Harold E. Trent Company

Illustrated literature on request

## BURLING INSTRUMENT COMPANY

5 VOSE AVENUE
SO. ORANGE, N. J.

# The GOTHAM CONVERTIBLE

# a recorder you never outgrow!

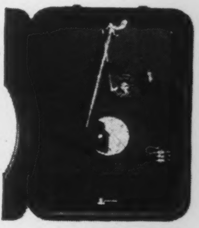
The most convertible, most interchangeable, most maintenance-saving instrument you've ever seen.

Deliberately designed so that the basic elements are identical for the 6", 9" and 12" chart size recorders. Temperature and pressure systems are also completely interchangeable. This flexibility enables you to convert instruments to suit your changing needs, at a minimum cost, minimum inventory, and without delay at the job site. Control through air relay or solenoid easily added. Full details in Catalogs 400 and 500.

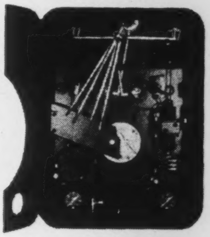
## What you can do with the Gotham Convertible

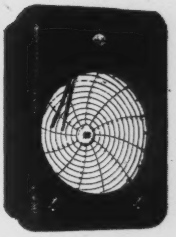
| *Function* | *Chart Size* 6" | 9" | 12" |
|---|---|---|---|
| **1-Pen Recorder** | X | X | X |
| **Single Temperature or Pressure Controller, Indicating** | X | X | X |
| **2-Pen Recorder*** | | X | X |
| **3-Pen Recorder*** | | | X |
| **4-Pen Recorder*** | | | X |
| **1-Pen Recorder-Controller** | | X | X |
| **2-Pen Recorder-Controller*** | | | X |
| **1-Pen Recorder-Controller and 1-Pen Recorder** }* | | | X |
| **1-Pen Recorder-Controller and 2-Pen Recorder** }* | | | X |

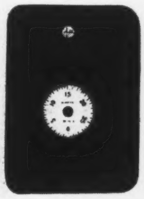
Functions above may be either Temperature or Pressure or Mixed (*)


IT'S A TEMPERATURE RECORDER

IT'S A PRESSURE RECORDER

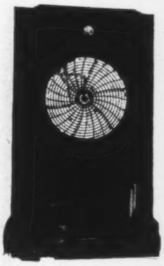

IT'S A TEMPERATURE OR PRESSURE RECORDER AND CONTROLLER


EXTERIOR OF THE GOTHAM CONVERTIBLE



### AUTOMATIC TIMING CONTROLLER

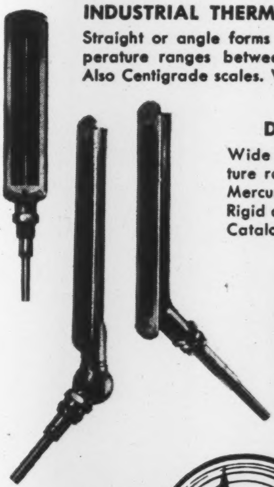
Multiple cam type, designed to start and control a sequence of process operations. Opens or closes air valves or electric switches. Available in single cam type. Write for Catalog 500.



### RECORDING PSYCHROMETER

Wet and dry bulb. Motor driven suction-type blower. Standard chart drive. Similar design available for Recording and Recording-Controlling Hygrometers. Write for Catalog 400.

**PORTABLE RECORDERS**—Handy, light-weight, mercury or vapor actuation, 6", 9", 12" chart sizes. See Catalog 400.



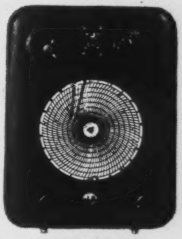
### INDUSTRIAL THERMOMETERS

Straight or angle forms for all purposes. Temperature ranges between —40°F. and 950°F. Also Centigrade scales. Write for Catalog 100.

### DIAL THERMOMETERS

Wide variety of case styles, temperature ranges, connections and fittings. Mercury, vapor, or gas-actuated. Rigid and adjustable stems. Write for Catalog 200.

40
60
80
100
120
140
160
180
200
220
FAHR HEIT



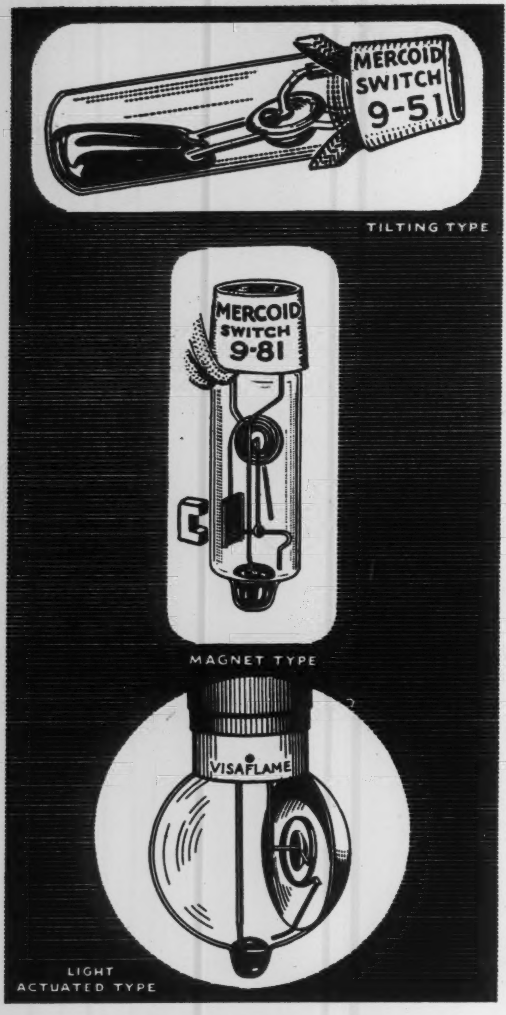
### PROGRAM CONTROLLER

Controls either temperature or pressure vs. time. Controls and records time, rate of rise, hold value, and rate of cooling. All adjustments in this new instrument made from outside of case. Write for Catalog 500.

*Keep Everything Under Control With Gotham*

**GOTHAM INSTRUMENTS**

Division of AMERICAN MACHINE AND METALS, INC.
Sellersville, Pennsylvania



# MERCOID
# MERCURY SWITCHES
## HERMETICALLY SEALED

There are three primary operating types of Mercoid mercury switches as illustrated.

Tilting Type, of which there are a variety of sizes, electrical capacities and circuit arrangements.

Light Actuated Stationary Type—circuit in this mercury switch closes in the presence of light of a flame and opens when the light is absent.

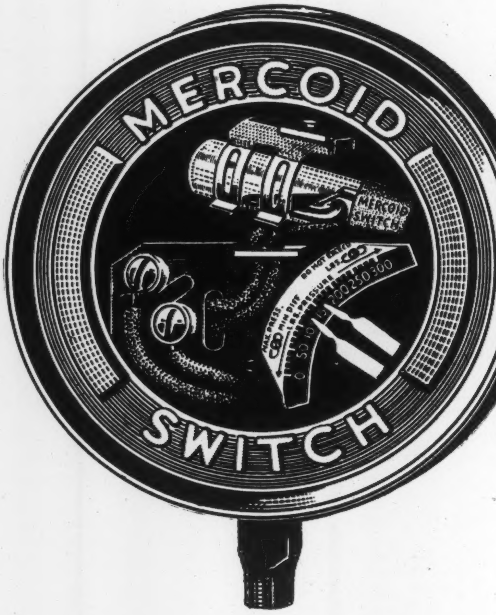
Magnetic Type, applied in a stationary position. The circuit is opened or closed by means of a permanent magnet; however, a small milli-ampere electromagnet may be employed.

There are many outstanding advantages of Mercoid mercury switches. They are immune to dust, dirt or corrosion and will operate indefinitely without deterioration.

They are all adaptable for numerous applications where open contacts are not suitable.

***OUR ENGINEERING DEPARTMENT WILL ASSIST YOU ON ANY OF YOUR SWITCH PROBLEMS***

# MERCOID
## AUTOMATIC CONTROLS
## *The Choice of Experienced Engineers*



## CONTROLS
## FOR INDUSTRIAL APPLICATIONS REQUIRING POSITIVE CONTROL OF PRESSURE, TEMPERATURE, LIQUID LEVEL ETC.

SIMPLE TO ADJUST FOR THE SPECIFIED OPERATING RANGE

MERCOID CONTROLS ARE EQUIPPED WITH MERCURY SWITCHES, THEREBY INSURING GREATER SAFETY, BETTER PERFORMANCE AND LONGER CONTROL LIFE

**WRITE FOR CATALOG 700---PLEASE MENTION THIS PUBLICATION**

**BRANCH OFFICES • 205 East 42nd Street, NEW YORK • 3137 North Broad Street, PHILADELPHIA**

THE MERCOID CORPORATION · 4223 BELMONT AVENUE · CHICAGO · 41 · ILLINOIS

*Manufacturers of dependable automatic controls for over a quarter of a century*

**Superior Tube Company** produces round and shaped tubing in the following analyses:

(.010″ to ⅝″ O.D. Max. Certain Analyses .035″ max. wall to 1⅜″ O.D.)

Carbon Steels:
A.I.S.I. C-1008, MT-1010, MT-1015, C-1118, MT-1020, C-1025, C-1035, E-1095.

Alloy Steels:
A.I.S.I. 4130, 4132, 4140, 4150, 8630, E-52100.

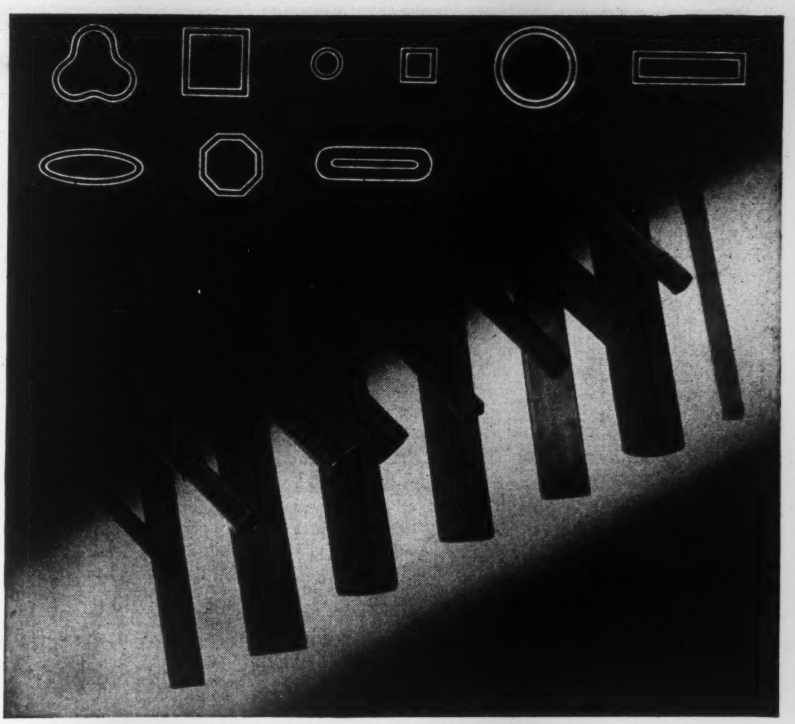
Stainless Steels:
A.I.S.I. 303, 304, 305, 309, 310, 316, 317, 321, 347, 403, 410, 420, 430, 446, T-5.

Nickel and Nickel Alloys:
Commercial Nickel, "D" Nickel (4½% Mn Nickel), "L" Nickel, "Monel", "K" Monel, "Inconel", "Inconel X", Nichrome "V", 30% Cupro Nickel, 18% Nickel Silver.

Beryllium Copper

• • •

**Superior Tube Company is represented in all principal cities of the United States and Canada by selected distributor organizations with warehouse facilities.**



## *UNLIMITED*
## DESIGN POSSIBILITIES

For the instrument maker, Superior furnishes tubing in cut, multiple or random lengths, shaped to "standard" specifications—or your specialized designs. Flat and elliptical ovals for bourdon springs can be produced in any analysis shown in the accompanying table.

Superior Shaped Tubing Specification and Tolerance Sheets list all the shapes and sizes for which tools are prepared and in stock. While the specification sheets are not available for general distribution, a Superior representative will gladly call at your office to review your dimensional, analysis and delivery requirements.

You are invited to make full use of this Superior service—your request will receive prompt attention.

Superior

THE BIG NAME IN SMALL TUBING

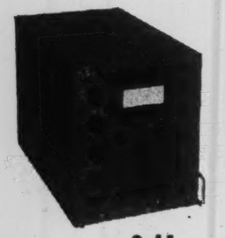
ALL ANALYSES .010″ TO ⅝″ O.D.
CERTAIN ANALYSES (.035″ MAX. WALL) UP TO 1⅝″ O.D.

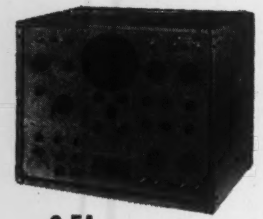
**SUPERIOR TUBE COMPANY**
**2014A Germantown Ave., Norristown, Pa.**

For Superior Tubing on the West Coast, call PACIFIC TUBE CO.
5710 Smithway St., Los Angeles 22, Cal. • UNderhill 0-1331

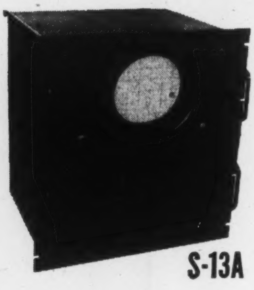
# THE WATERMAN LINE-UP

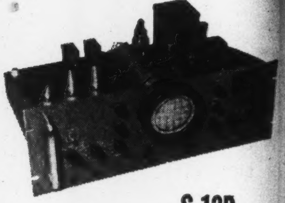
## PULSESCOPES


S-4A

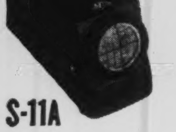

S-5A

## RAKSCOPES

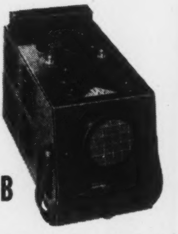

S-13A

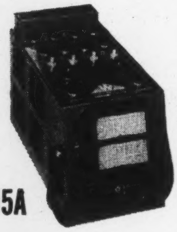

S-12B

## POCKETSCOPES


S-11A

S-14A


S-14B


S-15A

S-10B

## CONDENSED TABLE OF SPECIFICATIONS

| | | S-4A | S-5A | S-10B | S-11A | S-12B | S-13A | S-14A | S-14B | S-15A |
|---|---|---|---|---|---|---|---|---|---|---|
| CR TUBE | QTY & TYPE | 1—3KP1 | 1—3JP1 | 1—2AP1 | 1—3MP1 | 1—3RP1 | 1—7GP4 | 1—3RP1 | 1—3RP1 | 2—3SP1 |
| | VOLTAGE | 1000 | 3000 | 350 | 560 | 920 | 3000 | 900 | 900 | 900 |
| SCOPE | CHANNELS & TYPE | 1—AC | 1—AC | 1—AC | 1—AC-DC | 1—AC-DC | 1—AC-DC | 1—AC-DC | 1—AC-DC | 2—DC |
| | MARKERS $\mu$S | 10 and 50 | .2 to 500 | ....... | ....... | ....... | ....... | ....... | ....... | ....... |
| | CALIBRATION | YES | YES | ....... | ....... | ....... | ....... | YES | YES | YES |
| VERTICAL RESPONSE | MAX. RMS V/IN | .24 | 0.04 | 1.0 | .1 | 0.05 | 0.05 | 0.01 | 0.05 | 0.01 |
| | SINE CPS —2DB | 2—8.5 MC | 6—7 MC | 20—150 KC | 0—200 KC | 0—200 KC | 0—600 KC | 0—180 KC | 0—700 KC | 0—180 KC |
| | PULSE RISE $\mu$S | 0.035 | 0.045 | ...... | 2 | 1 | 0.4 | 1.8 | 0.35 | 1.8 |
| HORIZONTAL RESPONSE | MAX. RMS V/IN | ....... | 3 | 1.0 | 0.1 | 0.05 | 0.05 | 0.015 | 0.15 | 1.0 |
| | SINE CPS —2DB | ....... | 2—700 KC | 20—150 KC | 0—200 KC | 0—200 KC | 0—600 KC | 0—180 KC | 0—200 KC | 0—150 KC |
| | PULSE RISE $\mu$S | ....... | 0.5 | ....... | 2 | 1 | 0.4 | 1.8 | 1.8 | 3 |
| LINEAR TIME BASE | RANGE IN CPS | 80—800 KC | 8—800 KC | 10—50 KC | 3—50 KC | 5—50 KC | 0.5—50 KC | 0.5—50 KC | 0.5—50 KC | 0.5—50 KC |
| | TYPE | REP—TR—A—R | REP—TR | REP | REP | REP—TR | REP—TR | REP—TR | REP—TR | REP—TR |
| CASE | SIZE (APPROX.) | 17x9x11 | 13x16x14 | 10x4x6 | 11x5x7 | 9x19x7 | 14x19x21 | 12x6x7 | 12x6x7 | 12x6x7 |
| | WEIGHT | 31.5 | 60 | 5 | 8¾ | 30 | 110 | 12¾ | 14 | 16½ |
| POWER | INPUT—WATTS | 150 | 215 | 23 | 43 | 80 | 330 | 50 | 70 | 75 |

3 SP

## RAYONIC C-R TUBES (Available in P1-P2-P7 and P11 Phosphor)

3 MP

### TYPICAL OPERATION

| TUBE | VOLTS ANODE #2 | VOLTS ANODE #1 | VOLTS GRID #1 | V/IN D1, D2 | V/IN D3, D4 | MAX. VOLT ANODE #2 | MAX. VOLT ANODE #1 | VOLTS HEATER | CURRENT HEATER |
|---|---|---|---|---|---|---|---|---|---|
| 3SP | 1000<br>2000 | 165 to 310<br>330 to 620 | —28 to —67<br>—58 to —135 | 73 to 99<br>146 to 198 | 52 to 70<br>104 to 140 | 2750 | 1100 | 6.3 | .6 Amp. |
| 3MP | 1000<br>2000 | 200 to 350<br>400 to 700 | 0 to —68<br>0 to —126 | 140 to 190<br>280 to 380 | 130 to 180<br>260 to 360 | 2500 | 1000 | 6.3 | .6 Amp. |

*For further information write to*

**WATERMAN PRODUCTS COMPANY, INC.**
PHILADELPHIA 25, PA., U. S. A.

Cable Address
Poketscope
Phila.

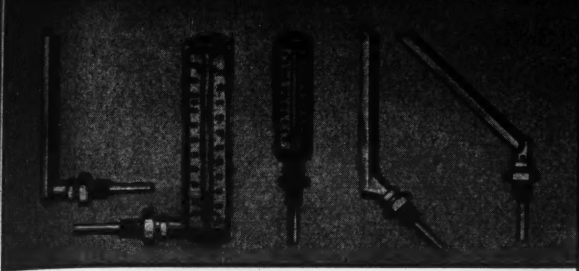
WATERMAN PRODUCTS

# MOELLER INSTRUMENT COMPANY

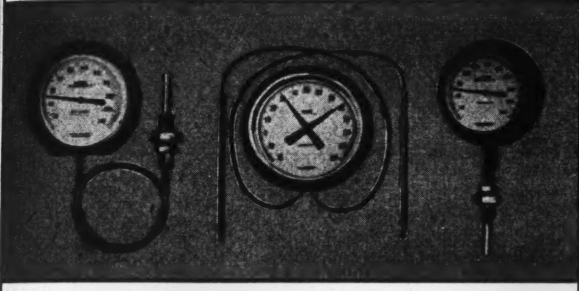
SINCE 1867

132nd STREET & 89th AVENUE, RICHMOND HILL, NEW YORK, N.Y., U.S.A.

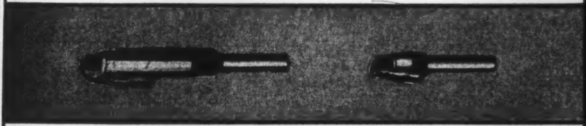
*Representatives in Principal Cities*



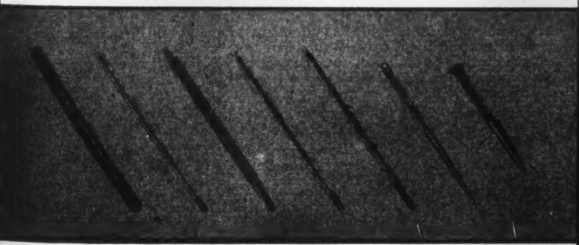
**MOELLER INDUSTRIAL THERMOMETERS** made in all forms, Straight, Angle, Right Side Angle, Left Side Angle, Reclined and Inclined Angles, in scale ranges from minus 120 to plus 1125°F. or its equivalent in centigrade. Available in 5", 7", 9" and 12" scale sizes with plain stems, union connection stems and separable sockets in all stem lengths and alloys.



**DIAL INDICATING THERMOMETERS,** Mercury Actuated, made in 4½", 6" and 8½" sizes with flexible extension tubing. Adjustable rigid stems, single or two pointers, plain bulb, union connection bulb or separable sockets in all lengths and alloys. Scale ranges from minus 40 to plus 1000°F. or its equivalent in centigrade.

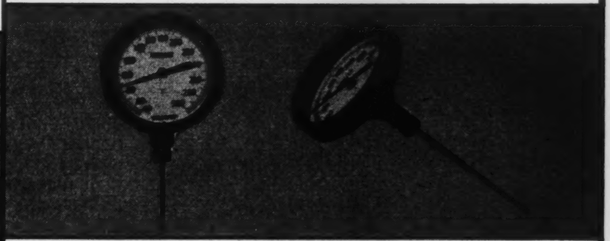


**THERMOMETER TEST WELLS, THERMOCOUPLE PROTECTING TUBES and WELLS,** made up in all sizes and alloys.

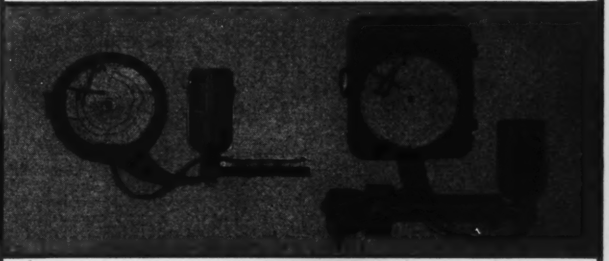


**ENGRAVED STEM and PORCELAIN and PAPER SCALE THERMOMETERS** made in ranges from minus 150 to plus 1125°F. or its equivalent in centigrade. Available in standard and extreme precision grade. Made to meet specifications of the Government, A.S.T.M. and other authoritative bodies.

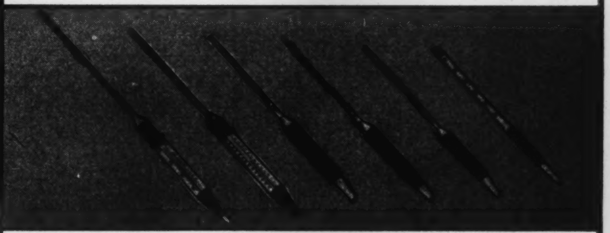
**RECORDING THERMOMETERS,** Mercury Actuated, made in the round or rectangular cases. Charts 10" or 12", 1 hour, 12 hour, 24 hour or 7 day. Ranges from minus 40 to plus 1000°F. or its equivalent in centigrade. Made in remote reading, direct reading, portable and self contained styles. Plain stems, union connection stems and separable sockets in all stem lengths and alloys.



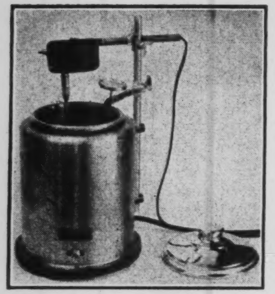
**MOELLER BI-METAL THERMOMETERS** are actuated by a powerful, specially processed bi-metal helix. Made with 5" diameter black crackle finish cast brass case. Rigid stainless steel stems, can be furnished with union connection bulb or separable sockets. 4½" diameter dial with scale ranges from minus 100°F. to 750°F.

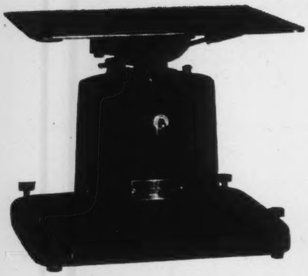


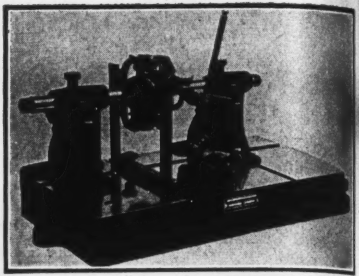
**RECORDING PSYCHROMETERS,** Mercury Actuated. Round and Rectangular Case, 12 hour, 24 hour or 7 day charts, self contained or remote reading, with or without motor driven fan.

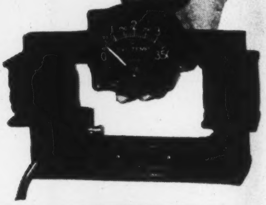


**HYDROMETERS PLAIN FORM or COMBINED with THERMOMETER.** Made in all scales specific Gravity or Baume for heavy and light liquids. Brix, Twaddle, Ballings Scales, etc. available for all liquids. Standard and commercial grades.









**MANY INDUSTRIES**

outside of aviation find that our unique test and calibration equipments possess exclusive features.

# BAROMETER CONTROLLER

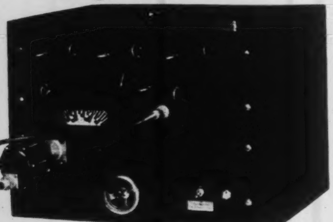
## FOR PRECISION CALIBRATION OF SENSITIVE ALTIMETERS AND OTHER PRESSURE INSTRUMENTS

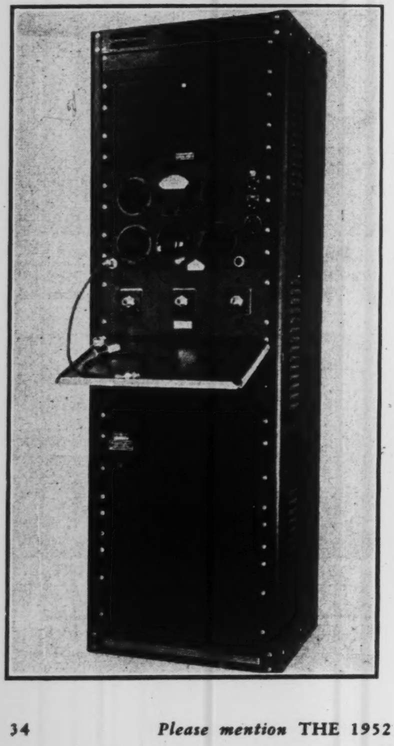
FEATURES of this instrument are: (1) Consistently accurate calibration tests with no possibility of errors of personnel . . . (2) High-precision mercurial basic barometer . . . (3) Photoelectric scanner sharper than human eye—reads closer than one-thousandth of an inch and never gets tired . . . (4) Mechanical positive stops at test points, each a micrometric reference . . . (5) No overshoot of the controlled pressure . . (6) will hold indefinitely at any test point . . . (7) Two-way automatic valve controlling both vacuum and pressure . . . (8) Compensations easily set for temperature, altitude, and latitude . . . (9) Rate of control fully adjustable.

*For complete information on this new instrument ask for Bulletin No. 1060C. Send also for descriptions of high-precision calibration benches, test stands and other Instrument Department necessities.*

**"Latest improvements including a dual scanner, with dual amplifier and control valve, providing for faster rate of control, still with the desirable feature of no overshoot."**

The new photoelectric scanning and control system will find many other applications in instrumentation. Complete control is achieved without the use of any contacts or relays, thereby assuring long, trouble-free service. Inquiries are invited in regard to the application of this system to specific control problems.





**IDEAL LABORATORY TOOL & SUPPLY CO.**

**3913 EVANS AVE.** **CHEYENNE, WYO.**

# Rockwell Equipment

*for precise measurement and control*

## Meters for Gas, Water, Oil and other Liquids; Gas Pressure Regulators

### DOMESTIC GAS METERS

Made in nine sizes, with capacities ranging from 150* to 500* cfh. Several of the smaller sizes have pressure cast aluminum alloy housings —others are cast iron or tin. Designed to cut maintenance costs.

**Meters rated for 0.60 sp. gr. gas at ½" pressure drop.*

### LARGE CAPACITY GAS METERS

Made in both cast iron and pressed steel types. Five models with capacities ranging from 1,800* to 10,000* cfh. Can be furnished with either Combined Record Gauges or the Emcorector to convert gas measured at high pressures to a low base pressure.

**Meters rated for 0.60 sp. gr. gas at 2" pressure drop.*

### FLOW INDICATING METERS

Especially designed to measure flow rates when setting, adjusting or testing appliances. Also useful in laboratories. Reads directly in cfh. Special scales are available. Three sizes, with capacities ranging from 0-2.5 cfh. to 0-500 cfh.

### ORIFICE METERS

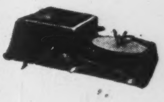
Measure accurately over a wide range of pressures and volumes by the orifice plate differential principle. Feature leak-proof Teflon stuffing box, positive inking pens, interchangeable high side chambers. Models available for 20", 50", 100", 200", 300" and 400" differential.

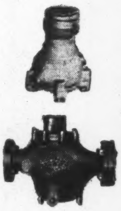
### CHART DRIVES

Dependable, convenient timing drives for meters, controls, recorders. Two models, the Midget for use in instruments where space is at a premium; the Standard for replacement service. Simple speed changing turrets assure flexibility in application.

### ORIFICE CHART INTEGRATORS

The operator of a Rockwell integrator mechanically computes the total extension of flow meter charts by retracing the differential and static chart records as made by the meter. This total appears on a direct reading counter.



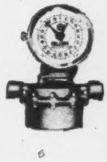


### WATER METERS

The most complete range of sizes and models made. Types include oscillating piston, disc, current, and compounds. Straight reading or circular registers optional. Sizes ⅝" to 6"—capacity range from 20 gpm to 1600 gpm.

### INDUSTRIAL METERS

Rockwell industrial meters provide dependable quantitative records of liquids used in batching, blending, processing. These meters are also used for formula and cost control. Practically any liquid that can be piped can be metered. Sizes ½" to 3".

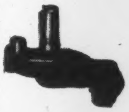


### GASOLINE AND OIL METERS

Rockwell makes a complete line of petroleum meters for guarding and guiding the flow from well head to service station pump. Types include production, pipeline, loading rack, tank truck and dispensing pump meters. Sizes from ½" to 6".

### APPLIANCE REGULATORS

Provide highest burner efficiency, prevent pilots from being extinguished on all types of gas burning appliances. Sizes ⅛" through 3".



### SERVICE REGULATORS

Reduce distribution line pressures in psi to controlled utilization pressures in inches of water. Two models, sizes ¾", 1", 1¼", 1½" and 2".

### BALANCED VALVE REGULATORS

***With Instrument Control***

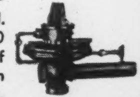
One of a complete selection of high and low pressure large volume regulators. Instrument control permits precise setting and pressure response. Other standard controls include pilot loading, spring loading, lever and weight. Low pressure regulators are either inside or outside weighted. Sizes 2" to 12".

### INDUSTRIAL REGULATORS

The Rockwell "120" controls outlet pressures from 1 psi to atmospheric pressure or less with inlet ranging up to 5 psi. Sizes ¾" to 6".

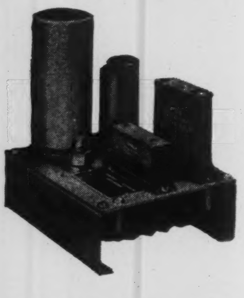
### "1001" REGULATORS

A general purpose control. Reduces inlet pressures of 200 psi or less to outlet range of 2 oz. to 60 psi depending on spring selected and setting. Size 2" only.



## ROCKWELL MANUFACTURING COMPANY

**PITTSBURGH 8, PA.** Atlanta · Boston · Chicago · Columbus · Houston
Kansas City · Los Angeles · New York · Pittsburgh · San Francisco · Seattle · Tulsa



**TYPE 2001-2, BASIC UNIT**

Frequencies 200 to 2500 cycles. Dividers and Multipliers available for lower and higher frequencies. Miniaturized and JAN construction. Output, 6 volts.

**TYPE 2005, UTILITY UNIT**

Consists of Type 2001-2 and booster to provide 10 watts at 110V at precision frequencies from 50 to 500 cycles at input power frequencies of 50 to 500 cycles, 45 watts.

**TYPE 2121-A, LAB. STANDARD**

Outputs, 60 cycle, 0-110 Volts, 10 Watts; 120-240 cycle impulses. Input, 50-400 cycles, 45 Watts.

# Precision FREQUENCIES

## GUARANTEED ACCURATE TO 1 PART IN 100,000 (.001%)

**TYPE 2111, POWER UNIT**

50 Watt output. 0-110-220V at 60 cycles, or any frequency 50 to 1000 cycles. Input, 50-100 cycles, 275 watts.

THE basis of these frequency standards is an electronic fork which is temperature-compensated and hermetically sealed against humidity and barometric pressure.

Type 2001-2 and similar units are available independently. Complete instruments of our manufacture are used extensively by industry and the armed forces where unvarying, dependable high precision is required, such as for bombsights and fire control.

**WIDELY USED IN SUCH FIELDS AS:**

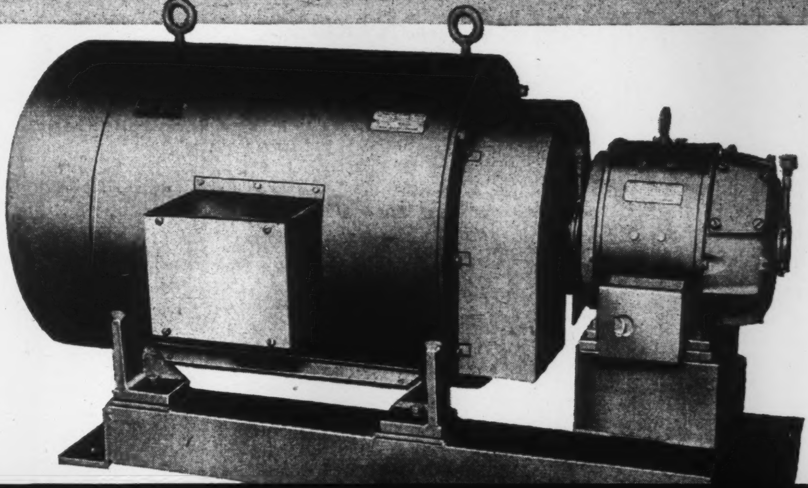
Aviation
Astronomy
Ballistics
High-Speed Photography
Viscosity Measurement
Nuclear Physics
Telemetering
Radiation Counting
Fluid Flow
Chemical Reaction
Navigation
School Laboratories
Industrial Research Labs.
Accurate Speed Control

**WHATEVER YOUR FREQUENCY PROBLEMS, OUR ENGINEERS ARE READY TO COOPERATE. PLEASE REQUEST DETAILS BY TYPE NUMBER.**

# American Time Products, Inc.

**580 Fifth Avenue** OPERATING UNDER PATENTS OF WESTERN ELECTRIC COMPANY **New York 19, N. Y.**

# Do You Have Use For Practically Pure
# 400 CYCLE POWER
## *Less than 1/2% total Harmonics?*



★ For use in Laboratory and Production testing of high performance electronic equipment Bogue has developed a line of single and three phase 400 Cycle Synchronous Motor-Generator Sets ranging from 3 to 100 KW with total harmonic content less than 1/2% This extreme quality in wave form is secured thru precision design, careful selection of material and quality control in manufacture.

Special units with less than 1/10% total harmonics available.

These sets can also be furnished with magnetic amplifier static voltage regulators when the utmost in reliability and constancy in voltage regulation is required. Output frequency is exactly 400 cycles at any load—no load to full load!

If you are interested in this type power, Bogue engineers will be glad to furnish oscillograms and wave analyses of typical sets built for this requirement. You can always depend on . . .

**QUALITY MAGNETIC AMPLIFIER CONTROLLED**

# BOGUE PRECISION POWER

**BOGUE ELECTRIC**
**MANUFACTURING COMPANY**
*Where Precision Coordinated Design... Counts!*
75 IOWA AVENUE • PATERSON 3, NEW JERSEY

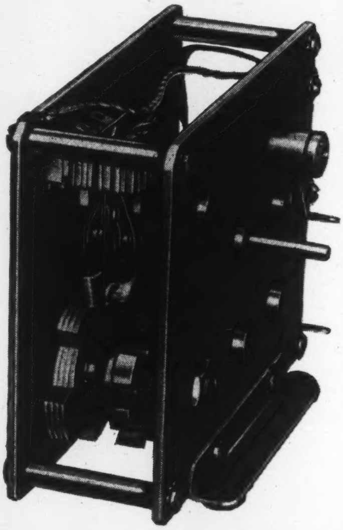
SINCE 1892 SPECIALISTS
Bogue
IN FINE MOTORS & GENERATORS

MAGNETIC AMPLIFIERS • MAGNETIC CONTROLLERS • AC & DC MOTORS
AC & DC GENERATORS • VOLTAGE & SPEED REGULATORS • SWITCHBOARDS

## AMGLO DC MOTOR

## ....WITH AC ACCURACY

**FOR ACCURATE TIMING CONTROL FROM BATTERIES OR DC LINE**



**SPEED**
Magnetic reed drive provides constant speeds with instantaneous self-start to full speed. Speeds from 1 REV. PER DAY to 900 REV. PER MINUTE.

**SIZE**
3½" x 2½" x 1⅝", wght.—10 oz. and 2" x 3½" x 3¾" wght.—15 oz.

**VOLTAGES**
From 3 to 110 Volts. These units are custom built to your requirements: voltage—current—speed—torque.

*Write for details and recommendations*

**AMGLO CORPORATION**

2037 W. Division St. Chicago 22, Illinois

---

## It's MILO—for SUPERIOR SUPPLY SERVICE!

**YOUR COMPLETE, DEPENDABLE**

*Source of Supply*

**for ALL ELECTRONIC PARTS and EQUIPMENT**

**IMMEDIATE DELIVERY from STOCK!**

***American Industry's Leading Electronic Distributor***

Leading research laboratories, electronic engineering firms, schools, colleges, government agencies and industrial manufacturers from coast-to-coast have long recognized MILO RADIO as their complete centralized, dependable source of supply for all their electronic material needs. You will find MILO SERVICE is unsurpassed in all departments when it comes to expeditious handling of your orders and inquiries. Try us the next time you seek fast action.

CONDENSERS • RESISTORS • TRANSFORMERS • METERS • LAB INSTRUMENTS • SWITCHES • RELAYS • RHEOSTATS • PLUGS • JACKS • WIRE • CONNECTORS • ELECTRONIC TUBES and thousands of other items!

SEND for THIS!
MILO

**FREE 1053 page CATALOG! *Purchasing Agents!***

Write today on your company letterhead for your free copy of our gigantic buying guide. An invaluable aid in your purchasing. Complete listing of all standard brand electronic material, with technical specifications. Address Dept. INY.

**For Complete Information**

**WRITE—WIRE—PHONE—or TELETYPE**

**For ULTRA-FAST SERVICE**
**TELETYPE NY1-1839**

**MILO RADIO & ELECTRONICS CORP.**

200 GREENWICH STREET, NEW YORK 7, N. Y. • Tel. BEekman 3-2980
Cable Address: MILOLECTRO • The ONE Source for ALL your electronic needs.

---

## HOW ARE YOUR INSTRUMENTS READ?

Your instruments have only one function . . . to be read . . . easily read . . . immediately read . . . accurately read. That is now possible, practical and surprisingly economical. SAMPSON Chemical and Pigment Corporation has combined technology and production "know-how" to utilize luminous materials at sensible cost through improved methods and mechanization of processes. We invite your inquiries.

### LUMINOUS MATERIALS

- Radioactive and fluorescent products for Air Force, Army and Navy contracts.
- Black Light fluorescent paints and pigments.
- Phosphorescent paints and pigments.

### LUMINOUS APPLICATIONS

- Modern facilities available for industrial productien runs and processing to meet Air Force, Army and Navy specifications.
- Luminous and self-luminous dials and pointers processed from components supplied.
- Luminous and self-luminous dials and pointers completely fabricated and prepared, from your blueprints to the finished part.

**SAMPSON**
**CHEMICAL & PIGMENT CORP.**
2830 W. Lake Street Chicago 12, Ill.

# Whether you want 1 or 1,000,000 gauges no maker's mark means more to you than USG

When you specify a United States Gauge you automatically benefit these ways:

**1.** You avail yourself of all the skill, experience, facilities and manufacturing know-how of the world's largest maker of gauges.

**2.** You gain the ingenuity that, for the past 47 years, has been applied to almost every type of gauge—the brains of top engineers and producers in a complex and exacting business.

**3.** You assure yourself the degree of accuracy you specify, whether it's USG laboratory precision, any of the ASA recognized standards, or special requirements for accuracy or duty demanded by Underwriters' Laboratories, Inc., Factory Mutual, or various U. S. Government agencies. Over 55 tests and inspections check quality before shipment.

**4.** You enjoy uniformity in manufacture, for USG is the only company of its kind producing all its parts in its own plant.

**5.** You inherit the technical advances of the United States Gauge Experimental Laboratory, the finest gauge development group in the nation.

## SPECIAL INSTRUMENT DEVELOPMENT

USG not only manufactures all types of commercial gauges but also many highly specialized instruments measuring from less than 1" of mercury absolute to 150,000 p.s.i.

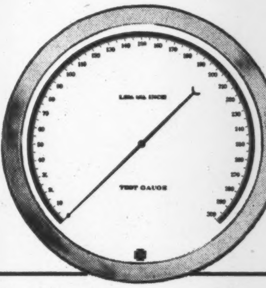
## UNITED STATES GAUGE STANDARDS LABORATORY

A completely modern laboratory equipped with many different primary masters covers the entire range of pressure sensing instruments. It contains, for example, absolute masters with a range of .005 to 1050 microns absolute and pressure-sensitive cells with a range of 0 to 150,000 p.s.i.

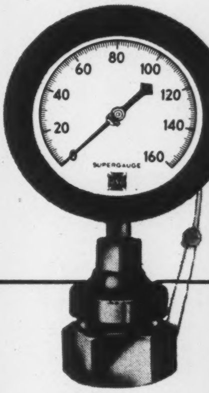
Write today for information about USG instruments. United States Gauge, Division of American Machine and Metals, Inc., Sellersville, Penna.

## 16" LABORATORY TEST GAUGE

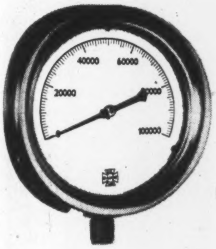
Accuracy—½ of 1% of the indicated reading above 20% of the maximum dial range and 0.2% of full scale over balance. Furnished with Certified Test Report. Sensitivity as high as 1 part in 10,000. Ranges 15 to 20,000 p.s.i. standard; special 30,000 p.s.i. or over.



## CHEMICAL GAUGES



Cleanout and protected types. Cleanout type used for viscous liquids requiring periodic cleaning; protected type designed for low-viscosity liquids. These gauges are rugged, will stand high overpressure. Ranges 30" vacuum to 1500 p.s.i.

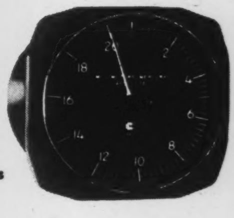


## HIGH PRESSURE SOLID FRONT GAUGES

For testing high pressure gases and liquids. Built to highest possible standards. Accuracy 1% of full scale reading up to 50,000 p.s.i., 2% of full scale reading on pressures over 60,000 p.s.i. Ranges 100 to 150,000 p.s.i.

## ABSOLUTE PRESSURE GAUGE

A highly accurate, dependable instrument for measuring absolute pressures. Ranges: 0 to 20 millimeters to 10 to 100 inches of mercury.



UNITED STATES GAUGE

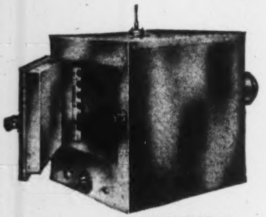
**PRODUCTS OF UNITED STATES GAUGE . . .** Absolute Pressure Gauges • Aircraft Instruments • Air Volume Controls • Altitude Gauges • Boiler Gauges • Chemical Gauges Mercury, Gas, and Vapor Dial Thermometers • Glass Tube and Industrial Thermometers • Flow Meters • Inspectors Test Gauges • Precision Laboratory Test Gauges • Marine, Ship and Air-Brake Gauges • Voltmeters • Ammeters • Welding Gauges.

***OTHER DIVISIONS OF AMERICAN MACHINE AND METALS, INC., AT SELLERSVILLE, PA.: GOTHAM INSTRUMENTS, AND AUTOBAR SYSTEMS***

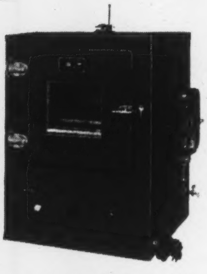
**Hotpack**

# LABORATORY EQUIPMENT

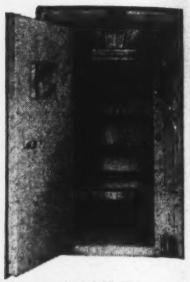
MECHANICAL
CONVECTED
OVENS



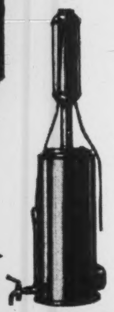
ECONOMY
FORCED
DRAFT OVEN



BACTERIOLOGICAL
INCUBATORS



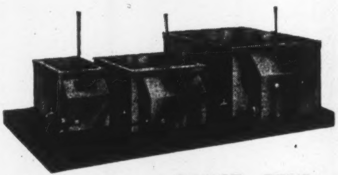
WALK-IN
CONST. TEM. ROOM



ELECTRIC-WATER
STILLS

*Write For Descriptive Catalog No. 51*

*The Hotpack Line For Quality and Economy*



CONST. TEMP.
WATER BATHS

**THE ELECTRIC Hotpack COMPANY, INC.**

COTTMAN AVE. AT MELROSE ST. • PHILADELPHIA 35, PENNSYLVANIA

---

RECORDERS
CONTROLLERS
INDICATORS

●

## ELECTROLYTIC CONDUCTIVITY MEASURING INSTRUMENTS

● Specialists in electrolytic conductivity measurements for both production and laboratory. Wide selection of portable and non-portable Solu-Bridges. Conductivity cells for every purpose.

● Let us help you with your electrolytic conductivity measuring problems, or write for our general catalog. Information gladly sent.

**Industrial Instruments**

17 POLLOCK AVENUE • JERSEY CITY 5, N. J.

---

# LICK YOUR CONTROL PROBLEMS

## WITH THE SNAP ACTION *Bell Switch*

- Temperatures to 400°
- Fine silver contacts
- Ceramic & Fiberglas insulation
- Alnico V Permanent Magnet
- 10 amps. at 110 volts; 5 amps. at 220 volts, A. C.
- Direct loads up to ¼ h.p., A. C. ratings

MORE and more designers are finding the Bell Switch just what they need to solve their control problems. The Bell Switch is a 100% positive snap action, magnetic proximity switch that is adaptable to any application where switch must be actuated through sealed barriers. Among the many applications in which it has been so successfully employed are cutoffs for all kinds of systems, counting devices, signal alarms and operation of automatic machinery. In addition to standard models, the Bell Switch is available in immersion-proof and splash-proof models to meet the demands of even the most severe services.

*Write for Detailed Information Concerning Sizes, Specifications and Application.*

**JO-BELL PRODUCTS, INCORPORATED**
4840 So. St. Louis Ave. • Chicago 32, Illinois
Liquid Level Controls • Carbonators • Magnetic Switches • Special Controls

# The 1952 Instruments Index

THIS issue of the INDEX has been compiled to meet the need of users of instruments and devices for measurement, inspection, testing and control, for a purchasing directory of such equipment. Since the 1950 INDEX, 249 companies' names and products, which have not appeared previously, were included; the names of 95 companies appearing in former issues of the INDEX have been removed; 278 name and address changes have been made. The INDEX is the most complete directory of instruments and devices for measurement, inspection, testing and control ever published. The number of companies included increased from 1363 in the 1950 INDEX to 1517 in this issue.

**This directory is arranged, indexed and cross-indexed to make its contents easily available.**

***The Index Section*—"Who makes what"—is the most important. Anyone who wants to know where he can buy or secure information on a certain product will find the product properly indexed and cross-indexed, and under it the names of the manufacturers of this equipment and manufacturers' sole representatives.**

***Indexing System.* Products are indexed under the main word. In cases where a name is ambiguous, or where the item is known under two or more names, companies making such devices are listed under one heading and cross-references inserted under the other headings.**

***Specific Terms.* You never are in need of "a gage", but of some particular kind of gage. Therefore we do not list manufacturers under broad general designations. For example, we do not list any names under the main heading "Meters" but we give the sources of supply for numerous classes and types of meters. Moreover, we do not list any names under "Meters, Liquid" alone, but we give under proper subheads the sources of supply for the *class* and *type* of liquid meter you may need.**

***Correctness of Headings.* As explained above, main headings and subheads are technically correct. A few are not scientifically correct: they are names in common usage, recognized for the convenience of the majority.**

***Correctness of Listings.* A few of the companies listed and advertising in the INDEX you already know. All of them are actively engaged in the manufacture of instruments and devices for measurement; inspection, testing and control. We have endeavored to list no firm names under specific headings unless the instruments made by such firms belong there by virtue of their design and construction. As a rule, we have to take the company's word that it could supply the product in question.**

***Completeness.* More than 1600 manufacturers were canvassed in the last four months. In the last few weeks we sent representatives to call on manufacturers. Therefore, the omission of any manufacturer's name under any heading is due to the negligence of someone in his own organization.**

**Every effort has been made to restrict the names in the Index Section to (1) the actual manufacturers and (2) the sole authorized sales agencies. On the other hand, whenever you desire to order at one time a variety of equipment made by different firms, you may find it most convenient to get in touch with a recognized, competent, "laboratory supply house." These houses are listed under *"Apparatus, Laboratory."***

***Instruments' Further Service.* This Index contains the answers to *only 99%* of your inquiries. If you cannot find the product or the name you want, communicate with the Information Section, Instruments Publishing Co., 921 Ridge Ave., Pittsburgh 12, and every effort will be made to furnish the information promptly.**

***Suggestions.* We shall appreciate suggestions regarding:**

1. **Headings not at present found in this Index which should be there,**
2. **Firms listed erroneously, and**
3. **Other inaccuracies which may have crept in despite all precautions.**

**Use this INDEX consistently. You will find the companies listed herein equipped to render the kind of service which saves time and helps make satisfied customers.**

**Where companies in whose products you are interested have omitted descriptions, your cooperation is invited in bringing this to the attention of the supplier or the publisher. Also, whenever the INDEX has aided you, please inform the manufacturer that his data in THE INSTRUMENTS INDEX were of help to you.**

# INDEX SECTION

**ABRASION MACHINES (See Testers, Abrasion)**

**ABSOLUTE PRESSURE INDICATORS (See Gages, Absolute Pressure)**

**ABSORPTIOMETERS**
Biddle Co.
Brabender Corp.
Jarrel-Ash
Photovolt Corp.
Rubicon Co.

**ACCELEROMETERS**
Aero Electronics
Alden Products
Alfax Paper & Engg.
Alpha Instrument Co.
Autoflight Insts. Div.
Baldwin-Lima-Hamilton
Bendix Pacific Div.
Brush Development Co.
Calidyne Co.
Cambridge Inst. Co.
Commercial Research
Consolidated Engg.
Cook Electric
Cramer & Co., Inc.
Doelcam Corp.
Eclipse-Pioneer Div.
Electro-Mec Lab.
Flight Research Eng.
General Elec. Co.
Genisco Inc.
Giannini & Co.
Gulton Mfg. Co.
Hastings Inst. Co.
Hathaway Inst. Co.
Heiland Research
Impact Register
Instrument Dev. Labs.
Jacobs Instruments
Kollsman Inst. Div.
Rutishauser Corp.
Schaevitz Engineering
Servomechanisms, Inc.
Statham Labs.
Sylvan Electronic Labs.
Sylvania Elec. Prods.
Thwing-Albert Inst. Co.
Trimount Inst. Co.
Van Dyke Instruments
Vectron, Inc.
Vibration Specialty
Waugh Labs.
Wiancko Engineering

**ACCELEROMETERS, Linear**
Aero Electronics
Consolidated Engineering
Electro-Mec Lab.
Engineering Res. Assoc.
Engr. Research & Dev.
Genisco Inc.
Giannini & Co.
Gulton Mfg. Co.
Industrial Electronics
Massa Labs.
Pacific Div.
Rutishauser Corp.
Statham Labs.
Van Dyke Insts.
Vectron, Inc.
Wiancko Engineering

**ACCELEROMETERS, Torsional**
Aero Electronics
Commercial Research
Doelcam Corp.
Flader Inc., Fredric
Flight Research Eng.
Giannini & Co.
Hathaway Inst. Co.
Kollsman Inst. Div.
Schaevitz Engg.
Summers Gyroscope
Statham Labs.
Trans-Sonics, Inc.
Vectron, Inc.

**ACIDIMETERS**
Freas Glass Works
Hellige, Inc.
Henszey Co.
Macbeth Corp.
Massa Laboratories
National Tech. Labs.
Rieker Inst. Co.
Rubicon Co.
Ruehfel Co.
Schultheis Corp.
Tagliabue Div.
Taylor & Co., W. A.
Thwing-Albert Inst. Co.
Uehling Instrument Co.

**ACOUSTIMETERS (See Sound Level Meters)**

**ACTUATORS, Electric**
AiResearch Div.
Askania Regulator
Breeze Corp.
Cleveland Fuel Equip.
Engr. Research & Dev.
Globe Industries
Oster Mfg., John
Schwien Engr.

**ACTUATORS, Hydraulic**
Adel Precision Prods.
Autoflight Insts. Div.
Automatic Products
Eclipse-Pioneer Div.
Gadgets, Inc.
General Electric
Hagan Corp.
Hammel-Dahl Co.
Hydraulic Controls
Infilco Inc.
Leupold & Stevens
Martin-Hubbard Corp.
Republic Flow Meters

**AEROGRAPHS**
Alden Products
Alfax Paper & Eng.
Eclipse-Pioneer Div.
Instruments Corp.

**AEROMETERS**
Friez & Sons

**AIR ANALYSIS APPARATUS (See Gas Analyzers, Air)**

**AIR COMPRESSORS, Instrument**
Ingersoll-Rand
Nash Engineering

**AIRCRAFT FLIGHT ANALYZERS**
Aero Electronics
Aircraft Electronics
Autoflight Insts. Div.
Century Geophysical
Doelcam Corp.
Electronic Associates
Flader Inc. Fredric
Farrand Optical
General Electric
Hathaway Instrument
Impact Register
Librascope
Reeves Instrument
Servo Corp. of America
Techno Inst.
U. S. Gauge

**AIRCRAFT INSTRUMENT TOOLS**
Aircraft Electronics
Airdraulics Engineering
Burndy Eng. Co.
Eclipse-Pioneer
Gadgets, Inc.
General Elec. Co.
Ideal Lab. Tool
Lewis Engineering
Marshall Co.
North Amer. Inst. Co.
Schwien Engg. Co.
Sperry Gyroscope Co.
Standard Products

**AIRCRAFT NAVIGATIONAL INSTRUMENTS**
Aero Electronics
Autoflight Inst. Div.
Bausch & Lomb. Opt.
Boes Co., W. W.
Collins Radio Co.
Cook Electric
De Jur-Amsco
Doelcam Corp.
Eclipse-Pioneer Div.
Electronic Associates
Elgin National Watch
Farrand Optical
Fecker, Inc.
Federal Telephone
Fischer & Porter
Flader Inc. Fredric
Ford Inst. Co.
Gadgets, Inc.
General Elec. Co.
Giannini & Co.
Gurley, W. & L. E.
Harvey-Well Electronics
Hastings Inst. Co.
Hathaway Inst. Co.
Hickok Elec. Inst. Co.
Impact Register
Jaeger Watch Co.
Jardur Import
Kenyon Instrument
Kollsman Inst. Div.
Lear, Inc.
Link Aviation Devices
Machlett & Son
Manning, Maxwell & Moore
Marine Compass Co.
Martin-Hubbard Corp.
Maxon Corp.
Moisture Register Co.
National Co.
Radio Receptor Co.
RCA Div.
Reeves Instrument
Rieker Inst. Co.
Roller-Smith Co.
Schwien Engg. Co.
Servo Corp. of America
Simmonds Accessories
Sperry Gyroscope Co.
Standard Products
Summers Gyroscope Co.
Thwing-Albert Inst. Co.
Triplett Elec. Inst.
U. S. Gauge Co.
Varo Mfg. Co.
Vectron, Inc.
Westinghouse Elec.
Weston Elec. Inst. Corp.
Carl Zeiss, Inc.

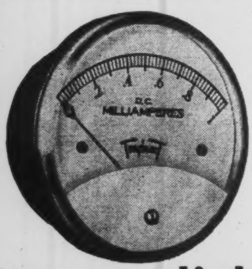
**AIRCRAFT POWER PLANT INSTRUMENTS**
Aero Instrument Co.
Aeromarine Inst. Co.
Airflow Instrument
Associated Research, Inc.
Beck Bros.
Bowser Inc.
Cambridge Inst. Co.
De Jur-Amsco Corp.
Eclipse-Pioneer Div.
Edison Inc., Thomas A.
Electro Products Labs.
Federal Telegraph Co.
General Elec. Co.
Hays Corp.
Hickok Elec. Inst.
Jaeger Watch Co.
Kenyon Instrument Co.
Kollsman Inst. Div.
Lewis Engg. Co.
Manning, Maxwell, Moore
Moisture Register Co.
Revere Corp.
Rieker Inst. Co.
Roller-Smith
Sperry Gyroscope Co.
Standard Products
Thwing-Albert Inst. Co.
Triplett Elec. Inst.
U. S. Gauge
U. S. Taximeter
Varo Mfg. Co.
Westinghouse Elec.
Weston Elec. Inst. Corp.
Winslow Co.

**AIR DISTANCE, Indicators & Recorders**
Aero Electronics
Collins Radio Co.
Eclipse-Pioneer Div.
Electronic Associates
Federal Telephone
Hastings Inst. Co.
Jaeger Watch Co.
Servo Corp. of America
Simplex Valve & Meter
Taller & Cooper
U. S. Gauge Co.
Vectron, Inc.

**AIR DRYERS, Instruments**
Anders Company
Davis Engineering Corp.
Hankinson Co.
Industrol Corp.
Logan Engr. Co.
Passaic Analytical Labs.
Pittsburgh Lectrodryer
Pritchard & Co.
Specialties Inc.

**AIR FLOW METERS (See Flowmeters, Gas)**

**AIR METERS (See Gas Meters, Positive)**



**Puts new light on "visibility"**

—the crystal clear plastic front with clean, rounded edges floods the scale with unobstructed natural light. The dial sets well up into the translucent cover, permitting full natural lighting from the top, sides and bottom. (No bezel or case rim interrupts light from any angle.)

—Another advantage—the full, open dial on this new 3" instrument gives much longer scale length than on conventional three-inch meters, yet the mounting and panel space is exactly the same.

—Your name or trademark can be shown with colorful emphasis.

Now—with competition getting keener—is a good time to improve your panels. Take a look at Model 321 PL soon.

FOR THE MAN WHO TAKES PRIDE IN HIS WORK
**Triplett**

TRIPLETT ELECTRICAL INSTRUMENT CO., BLUFFTON, OHIO, U.S.A.

*The Genisco*
"G" ACCELERATOR . . .

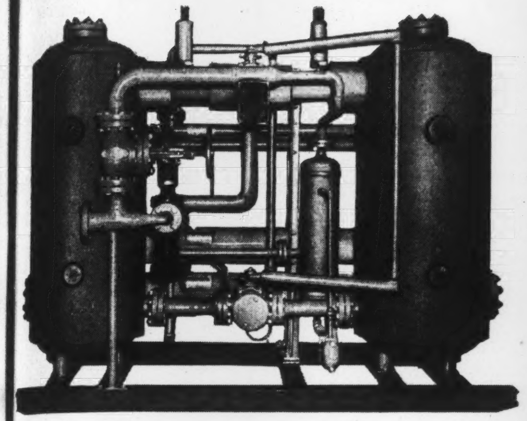
**. . . One of a group of precision laboratory acceleration testing devices, calibrating equipment, and flight instruments.**

**OTHER PRODUCTS:**

- ✓ **Linear Accelerometers,** *2—50G*
- ✓ **Acceleration Switches,** *Two Stage*
- ✓ **Analog Digital Converters,** *Electrical Output Counter*
- ✓ **Iconolog Series,** *Flight Film Data Reduction*

*And other devices for flight measurement, testing, control, and analysis.*

**Genisco** INCORPORATED
Dept II
2233 Federal Avenue
Los Angeles 64, Calif.



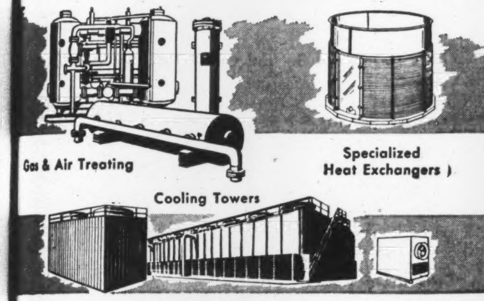
UNEXCELLED—
FOR DEHYDRATION
OF INSTRUMENT AIR!

## The Pritchard HYDRYER*

The Pritchard HYDRYER* is *unexcelled* for dependable dehydration of air for instrument and process controls. Dual adsorbers provide continuous drying action. Standard packaged units designed to reduce dew points of compressed air or other gases to minus (—) 40°F. Only service connections are required. Specially designed HYDRYER* units can be tailored to your individual requirements. Investigate today!

*Registered Trade Name

*Write Today for Bulletin No. 16.0.080*



Producers of QUALITY Specialized Process EQUIPMENT

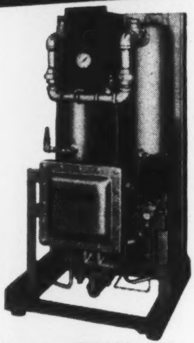
**J. F. Pritchard & Co.**
**EQUIPMENT DIVISION**
Dept. No. 154
908 Grand Ave., Kansas City 6, Mo.

District Offices: CHICAGO • HOUSTON • NEW YORK • PITTSBURGH
TULSA • ST. LOUIS • Representatives in Principal Cities from Coast to Coast

---

# Industrol

**INSTRUMENT AIR DEHUMIDIFIERS**



WRITE for Bulletin

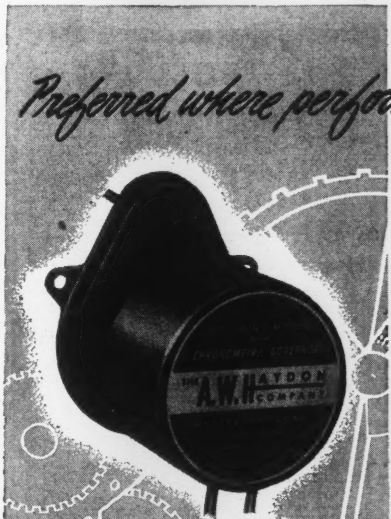
**Provide Air that is CLEAN, OIL-FREE and MOISTURE-FREE—the first requisite to dependable instrument operation. Designed by INSTRUMENT ENGINEERS who thoroughly understand instrument air system problems.**

Representatives in principal cities.

**Industrol**
CORPORATION
506 Westfield Ave., East
Roselle Park, New Jersey

---

*Preferred where performance is paramount*



## A. W. HAYDON

### D. C. TIMING MOTORS

### *with Chronometric Governor*

A primary power source of extreme accuracy, this revolutionary development of the A. W. Haydon Company is the first successful production combining the accuracy of a clock with the power of a motor. Made with jeweled movements, this extraordinary timer permits the solution of problems heretofore considered insurmountable.

*Special Features:*
- Extreme accuracy
- Wide range of voltage, load and temperature
- Reversible
- Compact
- Light weight

The
**A. W. HAYDON**
COMPANY
22' NORTH ELM STREET
WATERBURY 20, CONNECTICUT
Design and Manufacture of Electrical Timing Devices.

Write Today for catalog sheet giving full information of A. W. Haydon D.C. Timing Motors with Chronometric Governors.

**AIRPLANE CONTROLS MOVEMENT RECORDERS**

Aero Electronics
Century Geophysical
Cook Elec.
Eclipse-Pioneer Div.
Flight Research Eng.
General Elec. Co.
Hathaway Instrument
Kollsman Instrument
North Amer. Inst. Co.
Revere Corp.
Sheffield Corp.
Sound Apparatus

**AIRSPEED INDICATORS (See also Aircraft)**

Aeromarine Inst. Co.
Baldwin-Lima-Hamilton
Cook Electric
Eclipse-Pioneer Div.
Fuess, Inc.
Gadgets Inc.
General Elec. Co.
Giannini & Co.
Hastings Inst. Co.
Hathaway Instrument
Illinois Testing Labs.
Impact Register (Recorders)
Jaeger Watch Co.
Kollsman Inst. Div.
Meriam Co.
Schwien Engg. Co.
Servomechanisms, Inc.
Taller & Cooper
Wallace & Tiernan
Waugh Labs.
U. S. Gauge Co.
Zernickow Co.

**AIRSPEED INDICATOR TESTERS**

Amthor Test. Inst. Co.
Baldwin-Lima-Hamilton
Gadgets Inc.
Hathaway Instrument
Ideal Lab. Tool
Jaeger Watch Co.
Meriam Inst. Co.
Parks Co., Harry S.
Trimount Inst. Co.
Wallace & Tiernan

**AIR VELOCITY METERS**

Bacharach Ind. Inst.
Baldwin-Lima-Hamilton
Dwyer Mfg. Co.
Hastings Instruments
Illinois Testing Labs.
Precision Thermometer
Sheffield Corp.
Taller & Cooper. Inc.
Victory Engr.
Westberg Mfg. Co.

**ALARMS, Bearing Temperature**

Automatic Temp. Control
Clark Cooper Co.
Edison, Inc., Thomas A.
Fenwal, Inc.
General Electric
Powers Regulator
Precision Thermometer
Victory Engr.

**ALARMS, Bin-Level (See Controllers, Automatic, Granular Material)**

**ALARMS, Carbon Bisulphide**

Baird Associates
Davis Emergency Equip.

**ALARMS, Carbon Monoxide, Combustible Gas, etc.**

Baird Associates
Bullard Co.
Davis Emergency Equip.
General Elec. Co.
Johnson-Williams Ltd.
Mine Safety Appliances
Taller & Cooper
Wheelco Insts. Co.

**ALARMS, High, low water (See Alarms, Liquid Level)**

**ALARMS, Hydrogen Sulphide**

Baird Associates
Davis Emergency Equip.

**ALARMS, Inflammable Gas**

Bristol Co.
Bullard Co.
Davis Emergency Equip.
Engelhard, Charles
Engineering Labs., Inc.
General Electric
Johnson-Williams, Ltd.
Leeds & Northrup Co.
Mine Safety Appliances
Viking Instruments, Inc.
Wheelco Instruments Co.

**ALARMS, Liquid Level**

Aeromarine Inst. Co.
Autocall Co.
Automatic Control Co.
Bailey Meter Co.
Bin-Dicator Co.
Boston Auto Gage Co.
Bristol Co.
Brooks Rotameter
B.W. Controller
Campbell Co., J. A.
Clark Cooper Co.
Cook Electric
(Continued)
Cutler-Hammer, Inc.
Eclipse-Pioneer Div.
Electronic Prod. Co.
Fielden Instrument
Fischer & Porter
Foxboro Co.
Friez Instrument Div.
Hagan Corp.
Hays Corp.
Instruments Corp.
Jerguson Gage & Valve
Jo-Bell Products
Kieley & Mueller, Inc.
L. A. B. Corp.
Leupold & Stevens
Lumenite Co.
Magnetrol Inc.
Mason-Neilan Regulator
McAlear Mfg.
Mercoid Corp.
Minneapolis-Honeywell
Moore Products
Mosher Electronic
Northern Equip. Co.
Panellet, Inc.
Parks Co., Harry
Photoswitch, Inc.
Positel Mfg. Co.
Reliance Gauge Column
Republic Flow Meters Co.
Rochester Mfg.
Rockwell Engr.
Schade Valve Mfg. Co.
Shallcross Controls
Shand & Jurs Co.
Tagliabue Div.
Taylor Instrument Cos.
Thermo Instruments
Trimont Inst. Co.
Uehling Instrument
U. S. Gauge
Vapor Recovery Systems
Warrick Co.
Water Level Controls
Wheelco Instruments Co.
Wright-Austin Co.
Yarnall-Waring Co.

**ALARMS, Radiation**

Georator Corp.
Kelley-Koett Inst.
R-C Scientific Inst.
Western Radiation

**ALARMS, SMOKE (See Smoke Density Indicators)**

**ALIDADES (See Surveying Instruments)**

**ALKALIMETERS**

Ace Glass Inc.
Belco Glass, Inc.
Central Scientific Co.
Fisher Scientific Co.
General Elec. Co.
(Continued)
Hellige, Inc.
Kimble Glass Co.
Kontes Glass Co.
Rowe Radio Research
Rubicon Co.
Ruehfel Co.
Specialty Glass Co.
Tagliabue Div.
Taylor & Co., W. A.
Thwing-Albert Inst. Co

**ALTIMETER TESTERS**

Amthor Test. Inst. Co.
Baldwin-Lima-Hamilton
Fuess, Inc.
Hathaway Instrument
Ideal Lab. Tool
Kenyon Instrument Co.
Meriam Inst. Co.
Parks Co., Harry
Pioneer Instrument Co.
Standard Products
Trimount Inst. Co.
Wallace & Tiernan

**ALTIMETERS (See also Barometers, Altitude)**

**ALTIMETERS, Level Flight**

Aeromarine Inst. Co.
American Paulin
Baldwin Locomotive
Giannini & Co.
Kollsman Inst. Div.
U. S. Gauge

**ALTIMETERS, Surveying**

American Paulin
Bruning Co.
RCA Div.
Stratex Instrument Co.
Wallace & Tiernan

**ALTITUDE BAROMETERS (See Barometers, Altitude)**

**AMMETERS, A-c. Multi-range**

Associated Research
Bradshaw Instruments
Burlington Instrument
Dittmore & Freimuth
General Electric
International Inst.
Precision Apparatus Co.
Rawson Elec. Inst.
Roller-Smith
Simpson Electric Co.
U. S. Gauge Co.
Welch Scientific
Westinghouse Elec.

**AMMETERS, Clamp Type**

Columbia Elec.
Dale Instruments
Electronic Development
Ferranti Electric
General Electric
U. S. Gauge
Weston Elec. Inst.

**AMMETERS, Contact-making**

Assembly Products
Cole Instrument
Dittmore & Freimuth
Esterline-Angus Co.
General Electric Co.
Hickok Electrical Inst.
Lewis Engineering
Reliance Instrument Co.
Roller-Smith
Taco West Corp.
Triplett Elec. Inst.
Weston Electrical Inst.

**AMMETERS, Indicating**

Assembly Products
Associatiated Research
Beede Elec. Inst.
Burlington Inst. Co.
Cambridge Inst. Co.
Cole Instrument
Columbia Elec. Mfg.
Dale Instruments
De Jur-Amsco Corp.
Dittmore & Freimuth
Eclipse-Pioneer Div.
Electric Auto-Lite
Electric Design & Mfg.
Electro-Mech. Inst.
Electro-Tech Equip.
Electronic Development
Engelhard, Chas
Ferranti Electric, Inc.
General Elec. Co.
Hickok Elec. Inst. Co.
International Instrument
J-B-T Insts.
Lewis Engineering
Marion Electrical Inst.
Meters, Inc.
Miller, M. C.
Niagara Electrical Inst.
Norton Electrical Inst.
Precision Apparatus Corp.
Pyramid Inst. Co.
Radio City Products Co.
Rawson Elec. Inst. Co.
Reliance Instrument Co.
Rochester Mfg. Co.
Roller-Smith
Sendur Mfg.
Sensitive Research Inst.
Shurite Meters
Simpson Electric Co.
Sterling Mfg. Co.
Sticht Co., Herman
Sun Manufacturing
Taco West Corp.
Triplett Electrical Inst.
U. S. Gauge
Welch Mfg. Co
Westinghouse Elec.
Weston Elec. Inst. Corp.
Wheelco Inst. Co.
Winslow Co.

**AMMETERS, Laboratory Standard**

Burlington Instrument
General Electric
Rawson Elec. Inst.
Roller-Smith Co.
Sensitive Research Inst.
Welch Scientific
Weston Elec. Inst.

**AMMETERS, Microammeters**

Assembly Products
Ballantine Labs.
Beede Elec. Instrument
Burlington Inst. Co.
Burton-Rogers Co.
Cambridge Inst. Co.
Clough-Brengle Co.
Cole Instrument
Dale Instruments
De Jur-Amsco Co.
Dittmore & Freimuth
Electric Design & Mfg.
Electronic Development
Engelhard, Chas.
General Elec. Co.
Hickok Elec. Inst. Co.
International Instrument
Lewis Engineering
MacDonald Co. W. S.
Marion Electrical Inst.
Meters, Inc.
Millivac Instruments
National Tech. Labs.
Norton Electrical Inst.
Pfaltz & Bauer, Inc.
Precision Apparatus Co.
Pyramid Inst. Co.
Radio City Products Co.
RCA Div.
Rawson Elec. Inst. Co.
Roller-Smith
Sensitive Research Inst.
Shelby Inst. Co.
Simpson Elec. Co.
Sun Electric Corp.
Taco West Corp.
Tagliabue Corp., C. J.
Thwing-Albert Inst. Co.
Triplett Electrical Inst.
Triumph Mfg. Co.
Welch Scientific
Westinghouse Elec.
Weston Elec. Inst. Corp.
Wheelco Inst. Co.
Winslow Co.

**AMMETERS, Microammeters, A-c Rectifier**

Ballantine Labs.
Burlington Instrument
Dale Instruments
De Jur-Amsco Corp.
Dittmore & Freimuth
Electronic Development
General Electric
International Instruments
(Continued)

MODEL 247

POWER CIRCUIT ANALYZER
also
MODEL 102 CIRCUIT TESTER

- Custom built or special electrical equipment.
- Development and experimental work.
- Repair, servicing, calibrating and certification of electrical instruments and test equipment.

Ask for Bulletins

INSTRUMENT LABORATORIES
327 W. Walton Pl., Chicago 10, Ill.

— ERDCo —

PRECISION INSTRUMENTS

For Industry and Laboratory

Typical examples are:

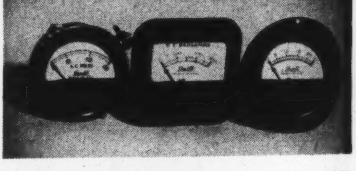
Subminiature Amplifiers
Indicators and controls
Tachometers — electrical, with or without contact with machine
Pressure Transducers
Photoelectric Controls
Machinery Analysis Stethoscope
Ultrasonic Oscillators and Transducers.
Custom Built Indicating and Control Devices

QUALITY

Write for Information.

ENGINEERING RESEARCH AND DEVELOPMENT CO.
Box 166 Hinsdale, Ill.

Shurite
TRADE MARK
ELECTRICAL MEASURING INSTRUMENTS



RUGGED • ATTRACTIVE • MODERATELY PRICED

TYPES—ammeters, milliammeters, voltmeters, AC and DC. Resistance meters.

ACCURACY—well within 5%. AC meters are double-vane, repulsion type; DC meters are polarized-vane solenoid type.

CASES—three basic styles, round or rectangular, all requiring 2-5/32" hole. Zero adjuster available on some D.C. models. Also pocket types.

DIALS—all metal—age and moisture resistant. Special calibrations, one to five colors.

USES—plate current and voltage readings; battery charging and emergency lighting units; TV antenna rotator indicators; voltage regulators; polarity indicators; plating sets, etc.

STOCKED—by leading electronics parts distributors. Ask for Bulletin F-53-SH.

SHURITE METERS
35-A Hamilton St • New Haven 8, Conn

Marion Elec. Inst.
Meters, Inc.
Roller-Smith
Simpson Electric Co.
Triplett Elec. Instrument
Welch Scientific
Westinghouse Elec.
Weston Elec. Inst.

### AMMETERS. Milliammeters

Assembly Products
Ballantine Labs.
Beede Elec. Instrument
Bradshaw Instruments
Bristol Co.
Burlington Inst. Co.
Burton-Rogers Co.
Cambridge Inst. Co.
Chicago Indust. Inst.
Clough Brengle Co.
Cole Instrument
Dale Instruments
De Jur-Amsco Corp.
Dittmore & Freimuth
Electric Design & Mfg.
Electro-Mech. Inst.
Electronic Development
Electronic Instrument
Engelhard, Chas.
Esterline-Angus Co.
General Elec. Co.
Hickok Elec. Inst. Co.
International Instrument
J-B-T Insts.
Lewis Engineering
Marion Electrical Inst.
Meters, Inc.
Miller, M. C.
National Tech. Labs.
Norton Electrical Inst.
Precision Apparatus Co.
Radio City Products Co.
Rawson Elec. Inst. Co.
RCA Manufacturing Co.
Reiner Electronics
Reliance Instrument
Roller-Smith
Sensitive Research Inst.
Shelby Instrument
Shurite Meters
Simpson Elec. Co.
Standard Science Sup.
Sun Electric Corp.
Supreme Inst. Corp.
Tagliabue Corp., N. J.
Thwing-Albert Inst. Co.
Triplett Electrical Inst.
Welch Scientific
Westinghouse Elec.
Weston Elec. Inst. Corp.
Wheelco Inst. Co.
Winslow Co.

### AMMETERS, Recording

Autocall Co.
Bristol Co.
Cambridge Inst. Co.
Cole Instrument
Dittmore & Freimuth
Edin Electronic
Engelhard, Chas.
Esterline-Angus Co.
Fielden Instrument
General Elec. Co.
HD Electric
Leeds & Northrup Co.
Massa Labs.
Metrotype Corp.
Precise Measurements
Roller-Smith
Sanborn Co.
Sound Apparatus
Sticht Co.
Tagliabue Div.
Taller & Cooper
Westinghouse Elec.
Wheelco Instrument

### AMMETERS. Split Core

Cole Instrument
Columbia Elec. Mfg.
Dale Instruments
Ferranti Electric
General Elec. Co.
HD Elec. Co.
Norton Electrical Inst.
Pyramid Inst. Co.
Roller-Smith Co.
Rubicon Co.
Sticht Co., Herman
Triplett Elec. Inst.
Weston Elec. Inst. Corp.

### AMMETERS. Surge-Crest

General Elec. Co.
Sensitive Research Inst.

### AMMETERS, Thermionic

Ballantine Labs.
Dale Instruments
General Radio Co.
Lewis Engineering
Meters, Inc.
Westinghouse Elec.

### AMMETERS, Thermo

American Elec. Chicago
Assembly Products
Burlington Inst. Co.
Cambridge Inst. Co.
Cole Instrument
Dale Instruments
De Jur-Amsco
Electronic Development
General Elec. Co.
Hickok Elec. Inst. Co.
Lewis Engineering
Marion Electrical Inst.
Meters, Inc.
Rawson Elec. Inst. Co.
Roller-Smith
Sendur Mfg.
Sensitive Research Inst.
Shelby Instrument
Simpson Electric Co.
Sun Manufacturing
Taco West Corp.
Triplett Electrical Inst.
Welch Scientific
Westinghouse Elec.
Weston Elec. Inst. Corp.

### AMMETERS, Thermo-Milliammeters

Assembly Products
Dale Instruments
Dittmore & Freimuth
Electronic Development
General Electric
International Instrument
Lewis Engineering
Meters, Inc.
Rawson Elec. Inst.
Roller-Smith
Sensitive Research Inst.
Simpson Electric Co.
Triplett Elec. Instrument
Welch Scientific
Westinghouse Elec.
Weston Elec. Instrument

### AMMETERS, Zero-Resistance

Hickok Elec. Inst. Co.
Marion Elec. Instrument
Miller, M. C.
Rockwell Engr.
Sensitive Research Inst.

### AMMONIA ANALYZERS (See Gas Analyzers, Ammonia)

### AMMONIA CONTROL EQUIPMENT

Arca Regulators, Inc.
Askania Regulator Co.
Bailey Meter Co.
Cash Co.
Fischer & Porter
Foster Engineering
Frick Co.
General Controls
Hammel-Dahl Co.
Hoke, Inc.
Lumenite Co.
Magnetrol, Inc.
Marsh Corp., Jas. P.
McAlear Mfg. Co.
Mercoid Corp.
Philadelphia Thermo. Co.
Phillips Petroleum
Photoswitch Inc.
Positel Mfg. Co.
Proportioneers, Inc.
Schutte & Koerting
Tagliabue Div.
Taylor Inst. Cos.
Taylor & Co., W. A.
Thermo Instruments
Wallace & Tiernan Prods.

### AMPEREHOUR METERS

Associated Research
Landis & Gyr, Inc.
Sangamo Electric Co.
Westinghouse Elec.

### AMPLIFIERS, A-c.

Aero Electronics
Airdesign, Inc.
Allied Radio Corp.
Amplifier Co.
Antenna Research Lab.
Assembly Products
Atomic Instrument
Audio Instrument
Audio Tone Oscillator
Automatic Temp. Control
Ballantine Labs.
Bark's Mfg. Co.
Bowen & Co.
Brown Electro-Measurement
Brush Development
Century Geophysical
Collins Radio Co.
Commercial Research
Concord Radio Corp.
Consolidated Engg.
Coulter Electronics
De Vry Corp.
Doelcam Corp.
Dorothea Mechanisms, Gale
Eclipse-Pioneer Div.
Edin Electronics
Electro-Mechanical Res.
Electronic Associates
Electronic Engr. Assoc.
Electronic Prod. Co.
Electro-Medical Lab.
Electronic Tube
Engineering Res. & Dev.
Farrand Optical
Feiler Engineering
Ferranti Electric
Ford Inst. Co.
Freed Transformer
Furst Electronics
General Elec. Co.
General Radio Co.
Geotechnical Corp.
Hathaway Instrument
Heiland Research Corp.
Hewlett-Packard
Instrument Dev. Labs.
Islip Radio Mfg.
Keithley Instruments
Krohn-Hite Inst.
Lear, Inc.
MacLeod & Hanopol
McFarlin Co.
Metron Instrument
Minnesota Electronics
Photron Instrument
Process & Instrument
Rauland-Borg Corp.
Raytheon Mfg. Co.
RCA Div.
Reiner Electronics
Robinette Co., W. C.
Rockwell Engr.
Rowe Engineering
Scott, Inc., Hermon
Servo Corp. of America
Servomechanisms, Inc.
Sherron Metallic
Standard Transformer
Sun Radio Co.
Southwestern Ind. Elec.
Techno Inst.
Tecktronix, Inc.
Thordarson Elec. Co.
Triumph Mfg. Co.
Walker-Jamieson, Inc.
Walkirt Co.
Waterman Products
West Coast Electronics
Wilson & Co.
Worner Electronics
Yellow Springs Inst.

### AMPLIFIERS, Audio Frequency (See Audio-Frequency Equipment)

### AMPLIFIERS, Commercial Frequency

Aero Electronics
Airdesign, Inc.
Amplifier Co.
Assembly Products
Bark's Mfg. Co.
Commercial Research
Concord Radio Corp.
De Vry Corp.
Dorothea Mechanisms, Gale
Feiler Engineering
Freed Transformer
Furst Electronics
General Electric Co.
General Radio Co.
Geotechnical Corp.
Hathaway Inst. Co.
Islip Radio Mfg.
Keithley Instruments
MacLeod & Hanopol
Martin-Hubbard Corp.
McFarlin Co.
Millen Mfg. Co.
Radio Receptor Co.
RCA Div.
Raytheon Mfg. Co.
Reeves Instrument
Reiner Electronics
Rockwell Engr.
Rowe Engineering
Sherron Metallic
Southwestern Ind. Elec.
Tektronix, Inc.
Televiso Co.
Thordarson Elec. Mfg.
Waterman Products

### AMPLIFIERS, D-c.

Aero Electronics
Allied Radio Corp.
Amplifier Co.
Antenna Research Lab.
Atomic Instrument
Audio Instrument
Beam Instruments
Pacific Div.
Brush Development
Century Geophysical
Cinema Engr.
Collins Radio Co.
Concord Radio Corp.
Consolidated Engg.
DeVry Corp.
Doelcam Corp.
Edin Electronics
Electro-Mechanical Res.
Electro-Medical Lab.
Electronic Associates
Electronic Engr. Assoc.
Electronic Prod. Co.
Electronic Tube
El-Tronics, Inc.
Engineering Res. & Dev.
Farrand Optical
Federal Telephone
Feiler Engineering
Ford Inst. Co.
Furst Electronics
General Elec. Co.
General Radio Co.
Geotechnical Corp.
Hathaway Instrument
Heiland Research
Industrial Control
Instrument Labs.
Islip Radio Mfg.
Lear, Inc.
Lewyt Metal Prod.
Liston-Falb
MacLeod & Hanopol
Magnetic Amplifiers
Manning, Maxwell, Moore
Martin-Hubbard Corp.
McFarlin Co.
Millen Mfg. Co.
Millivac Instruments
Minnesota Electronics
Perkin Elmer Corp.
Photovolt Corp.
Raytheon Mfg. Co.
RCA Div.
Reeves Instrument
Reiner Electronics
Rockwell Engr.
Rowe Engineering
Sanborn Co.
Servo Corp. of America
Servomechanisms, Inc.
Sherron Metallic
Southwestern Ind. Elec.
Summers Gyroscope
Techno Inst.
Tektronix, Inc.
Thordarson Elec. Mfg.
Transmitter Equipment
Varo Mfg. Co.
Walkirt Co.
Waterman Products
West Coast Electronics
Wilson & Co.
Yellow Springs Inst.

### AMPLIFIERS, Geophysical

Aero Electronics
Century Geophysical
Heiland Research
Midwestern Geophysical
Southwestern Ind. Elec.
Photron Instrument

### AMPLIFIERS, Linear

Aero Electronics
Antenna Research Lab.
Century Geophysical
Consolidated Engr.
Electro-Mech. Research
Engr. Research & Dev.
Feiler Engineering

(Continued)

HICKOK PORTABLES
AC & DC INSTRUMENTS

ACCURACY WITHIN ½ OF 1%

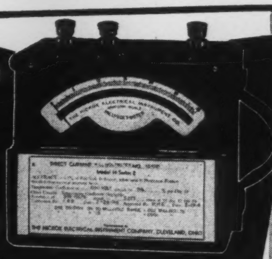
✓ Knife edge pointers
✓ Engraved scales
✓ Accuracies to 0.2 of 1% available

Model 14

HICKOK portables are available in Ammeters, Milliammeters, Voltmeters, Millivoltmeters, Wattmeters and Wattless Component Indicators. Housed in new type phenolic, steel lined case which shields the fine accuracy of these instruments from external magnetic fields. Errors caused by changes in ambient temperature are negligible.

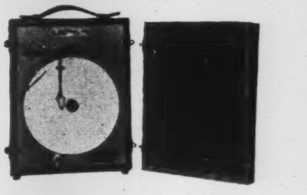
Write for the complete HICKOK Catalog No. 26 today.

THE HICKOK ELECTRICAL INSTRUMENT CO.
10519 DUPONT AVENUE • CLEVELAND 8, OHIO
THE STANDARD OF QUALITY FOR OVER FORTY YEARS



ANOTHER W&T PRECISION INSTRUMENT

THE PORTABLE DIRECT CURRENT RECORDER



FOR MEASUREMENT OF MICRO CURRENTS

The New W&T Portable Direct Current Recorder permits direct recording of minute electrical currents and voltages. Brief specifications are:

Type ............Moving Magnet, Interchangeable coil.
Sensitivity ........1 part in 1000 of full scale range.
Minimum Range...0 to 100 microamperes.
Maximum Range...0 to 6.0 amperes.
Coil Adjusting Range ..........2.3 to 25 ampere turns.
Scale Length.....2½ inches.
Chart Diameter..8 inches.
Chart Speed.....1 revolution per 24 hours.
Case ...........Highly finished hard wood.
Size .............13" high by 10⅛" wide by 5½" deep.
Weight .........10 pounds.

Write today for complete details — there's no obligation

WALLACE & TIERNAN PRODUCTS, INC.
ELECTRICAL MECHANISMS AND PRECISION INSTRUMENTS
Belleville 9, New Jersey • Represented in Principal Cities

A-89

Quality
INSTRUMENT COMPONENTS

FIXED AND VARIABLE AUDIO FREQUENCY ATTENUATORS

Cinema Controls are made to the highest degree of accuracy and have years of built-in service. Wiper blades and contacts are hand-lapped and matched. Precision types from 1/10 db. Over 500 models. Write for catalogue 11-Ax.

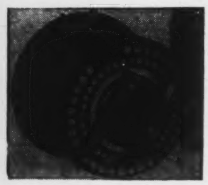
PRECISION INSTRUMENT TYPE ROTARY TAP SWITCHES

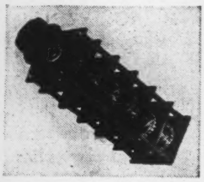
Using the same fine precision construction of Cinema attenuators these switches are built for dependability. Tailored to your custom requirements. Brass, Nickel Silver, and Coin Silver contacts.

*Write us giving your requirements.*

CINEMA ENGINEERING COMPANY
1510 WEST VERDUGO AVENUE, BURBANK, CALIFORNIA

Export Agents: Frazar & Hansen, Ltd. • 301 Clay Street • San Francisco, Calif., U. S. A.





Furst Electronics
Gulton Mfg. Co.
Industrial Electronics
Midwestern Geophysical
Millivac Instrument
Radiation Counter Labs.
Radioactive Products
Servo Corp.
Specialties Inc.
Swedish Gage Co.
Tracerlab

### AMPLIFIERS, Radio Frequency

Antenna Research Lab.
Audio Development
Browning Labs.
Clarke Inst. Corp.
Collins Radio Co.
Concord Radio Corp.
Electro-Mech. Research
El-Tronics, Inc.
Engineering Res. & Dev.
Feiler Engineering
Ferris Inst. Corp.
General Elec. Co.
Geophysical Inst. Co.
Harvey Radio Labs.
Heiland Research
Islip Radio Mfg.
Kay Electric
McFarlin Co.
Measurements Corp.
Millen Mfg. Co.
Phillips Petroleum
Polarad Electronics
Radio Receptor Co.
Raytheon Mfg. Co.
RCA Div.
Reeves Instrument
Reiner Electronics
Rowe Engineering
Servo Corp. of America
Sherron Metallic
Sperry Gyroscope Co.
Sylvan Electronic Labs.
Tektronix, Inc.
Triumph Mfg. Co.
Waterman Products
West Coast Electronics

### AMPLIFIERS, Vibration

Aero Electronics
Century Geophysical
Consolidated Engr.
Dice Co., J. W.
Electro-Products Labs.
Engr. Research & Dev.
Feiler Engineering
Furst Electronics
Gulton Mfg. Co.
Heiland Research
Industrial Electronics
Midwestern Geophysical
Scott Inc., H. H.
Southwestern Ind. Elec.
Sperry Gyroscope Co.

### AMPLIFIERS, Wideband

Electro-Mech. Research
Electronic Instrument
Engr. Research & Dev.
Feiler Engineering
Furst Electronics
General Radio Co.
Hewlett-Packard
Kalbfell Labs.
Marconi Inst. Ltd.
Polarad Electronics
Technology Inst. Corp.

### ANALYZERS, Chemical Composition, Recording & Controlling

Aero Electronics
American Inst. Co.
Applied Physics Corp.
Applied Research Labs.
Baird Associates
Beckman, Inc., Arnold O.
Cambridge Instrument
Coleman Electric Co.
Consolidated Engg.
Davis Emergency Equip.
Dietert Co., Harry W.
Edin Electronics
Fisher Scientific Co.
Friez Inst. Div.
General Elec. Co.
Industrial Instruments
Laboratory Equip. Corp.
Leeds & Northrup Co.
Macbeth Corp.
Machlett & Son, E.
Mine Safety Appliances
National Technical Labs.
Patwin Inst. Div.
Phillips Petroleum
Podbielniak, Inc.
Rowe Engineering
Rubicon Co.
Sargent & Co., E. H.
Scientific Glass App.
Skaneateles Mfg.
Tagliabue Div.

### ANALYZERS, Electric Wave

Edin Electronics
General Electric
General Radio Co.
Hewlett-Packard
Kay Electric Co.
RCA Div.
Scott, Inc, Hermon
Techno Inst.
Wilmotte, Inc.

### ANALYZERS, Electronic Circuit

Bradshaw Instruments
Dale Instruments
Electronic Development
General Electric
National Tech. Labs.
Precision Apparatus Co.
RCA Dev.
Westinghouse Elec.
Weston Elec. Inst.

### ANALYZERS, Flight

Aero Electronics
Aircraft Electronics
Century Geophysical
Edin Electronics
Flight Research Eng.
General Electric
Genisco Inc.
Hathaway Instrument
Reeves Instrument
Techno Inst.

### ANALYZERS, Gas (See Gas Analyzers)

### ANALYZERS, Infrared

Applied Physics Corp.
Baird Associates
Liston-Folb
Mine Safety Appliances
Perkin-Elmer Corp.

### ANALYZERS, Ignition System

Fox Valley Inst.
Hickok Elec. Inst.

### ANALYZERS Industrial Circuit Tester

Aero Electronics
Bradshaw Instruments
Cincinnati Clock
Dale Instruments
Electronic Development
Feiler Engineering
Flight Research Eng.
General Electric
Instruments Labs.
Precision Apparatus
Roller Smith
Triplett Elec. Inst.
Westinghouse Elec.
Weston Elec. Inst.

### ANALYZERS, Industrial Power

Cincinnati Clock
Cole Instrument
Edin Electronics
Elec. Facilities, Inc.
Electro-Products Labs.
Electro-Tech. Equip.
Esterline-Angus
General Electric
Instrument Labs.
Sticht Co., Herman
Triplett Elec. Inst.
Westinghouse Elec. & Mfg.
Weston Elec. Inst. Corp.

### ANALYZERS, Radio Set

Aerovox Corp.
Amerline
Audio-Tone Oscillator
Bradshaw Instruments
Chicago Indust. Inst.
Clough-Brengle Co.
Communication Meas. Lab.
Dale Instruments
Electronic Development

(Continued)

Electronic Instrument
Electro Products Lab.
Feiler Engineering
General Electric Co.
General Test. Equip.
Harvey Radio Labs.
Hickok Elec. Inst. Co.
Jackson Electrical Inst.
Kay Electric
Kepco Labs.
Lyman Electronic
MacLeod & Hanopol
Measurements Corp.
Meters, Inc.
Precision Apparatus Co.
Radex Corp.
Radio City Products Co.
Raytheon Mfg. Co.
RCA Mfg.
Reiner Electronics
Roller Smith
Sherron Metallic
Simpson Elec. Co.
Supreme Instruments
Sylvania Elec. Prod.
Triplett Elec. Inst. Co.
Triumph Mfg. Co.
Universal Inst. Co.
Waterman Products Co.
Westinghouse Elec.
Weston Elec. Inst. Corp.

### ANALYZERS, Sound

Aircraft Electronics
Amperite Corp.
Clough-Brengle Co.
Electro Products Lab.
Electronic Associates
Engineering Res. & Dev.
Feiler Engineering
General Elec. Co.
General Radio Co.
Hewlett-Packard
Hickok Elec. Inst. Co.
Kay Electric
Minnesota Electronics
RCA Manufacturing Co.
Scott, Inc., Hermon
Techno Inst.
Western Electric
Westinghouse Elec.
Weston Elec. Inst.

### ANEMOMETERS, Hot-wire

Friez Inst. Div.
Hastings Inst. Co.
Serdex, Inc.
Victory Engr.
Willson Products, Inc.

### ANEMOMETERS, Mechanical.

Alina Corp.
American Inst. Co.
Beckman & Whitley
Dietzgen Co.
Eclipse-Pioneer Div.
Flight Research Eng.
Friez Instrument
Geophysical Inst. Co.
G. M. Mfg. Co.
Gray Instrument
Green Henry J.
Instruments Corp.
Kenyon Instrument Co.
Keuffel & Esser Co.
Mine Safety App. Co.
Mico Instrument Co.
Revere Corp.
Rieker Inst. Co.
Spence Engineering Co.
Stewart, M. C.
Taylor Inst. Cos.
Wallace & Tiernan
Westberg Mfg. Co.
Wilson Products, Inc.

### ANGULAR MOMENTUM DEMONSTRATOR

Eastern Science Co.
Mico Instrument Co.
Sorenson & Co.

### APPARATUS, Laboratory

American Inst. Co.
Anetsberger Bros.
Baird Associates
Baltimore Biological Lab.
Bausch & Lomb Opt.
Belco Glass, Inc.
Berge, J. & H.
Best Scientific Glass
Bethlehem Apparatus Co.
Boekel & Co.
Boonton Radio Corp.
Braun Corp.
Braun-Knecht-Heimann
Buffalo Apparatus Corp.
Burrell Tech. Supply Co.
Calkins Co.
Callahan & Co.
Calta Glass Works
Cargile, R. P.
Central Scientific Co.
Chandler & Stedman
Chemical Rubber Co.
Chicago Apparatus Co.
Chicago Surgical
Clay-Adams Co.
Colloid Equipment Co.
Curtin & Co.
Cuthbert Co.
Daigger & Co.
Dearborn Scientific
Demuth Glass Works
Denver Fire Clay Co.
Distillation Products
Doerr Glass Co.
Douglas Radio Labs.
Eastern Scientific Co.
Eaton-Dikeman Co.
Eberbach & Sons
Electro-Medical Lab.
Electro-Products Labs.
Electro Tech. Equip.
Empire Lab. Supply
Erb & Gray
Ervin Co.
Fassett Co.
Feiler Engineering
Ferguson Co.
Ferner Co.

(Continued)

Fisher Scientific Co.
Flett Laboratory
Food Technology, Inc.
Freas Glass Works
Fredericks, George E.
Freed, J. Melvin
Gaertner Scientific Corp.
Gardner Laboratory
General Biological Supply
Genisco, Inc.
Gerrish-Padgett Corp.
Gertsch Products
Goetze Niemer Co.
Gorrell & Gorrell
Gotham Scientific Co.
Greene Bros., Inc.
Greiner, Inc., Emil
Griner Co., A. J.
Hausser & Son
Heil Corp.
Hoke, Inc.
Howe & French, Inc.
Industrial Scientific
International Equip.
Jerguson Gage & Valve
Kalbfell Labs.
Kansas City Lab. Supply
Kauffman-Lattimer Co.
Koch & Co.
Kontes Glass
Laboratory Const. Co.
Laboratory Equip. Co.
Laboratory Materials Co.
Laboratory Specialties
LaPine & Co.
Levitt Ferguson Co.
Lindly & Co.
Lovins Engr.
Macalaster Bicknell
Machett & Son
Mahady Co.
Maris Co., John M.
M. B. Mfg. Co.
McKesson-Doster-Northington
Menlo Research Lab.
Merz Engineering
Meyer Scientific Supply
Microchemical Service
Millen Mfg. Co.
Milo Rdo. & Electr.
Mine & Smelter Sup. Co.
Nashville Surgical Supply
National Scientific Corp.
Nester Co., Inc.
N. J. Laboratory Supply
N. Y. Laboratory Supply
New York Scien. Supply
Palo-Meyers, Inc.
Phipps & Bird, Inc.
Podbielniak, Inc.
Precise Measurements Co.
Precision Scientific Co.
Premier Crystal Labs.
Rascher & Betzold
R-C Scientific Inst.
Refinery Supply Co.
Rochester Lab. Supply
Roemer Drug Co.
Rupp & Bowman Co.
Sargent & Co.
Schaar & Company
Scientific Glass App.
Scientific Supplies Co.
Servomechanisms, Inc.
Standard Glass App.
Standard Science Sup.
Standard Scientific
Steel City Testing Mach.
Steele, Erick F.
Stoelting Co., C. H.
Technical Products Co.
Tenney Engr.
Thomas Co. Arthur H.
Uhrig Co., J. F.
University Apparatus Co.
Walker & Co., Geo. T.
Welch Scientific
Western Machinery Co.
Western Scientific Co.
Wheaton Co., T. C.
Wilkens-Anderson Co.
Will Corporation
Williams Apparatus Co.
Williams, Brown & Earle
Woods "Lab. Apparatus"
Yonkers Lab. Supply Co.

### APPARATUS, Laboratory, Fused Quartz

Crystal Research Labs.
Distillation Products
Eastern Industries
Electro Products Labs.
Electronic Products
Erb & Gray
Farrand Optical
Ferguson Co.
Fischer & Porter
Fish-Schurman Corp.
General Electric Co.
G. M. Mfg. Co.
Hanovia Chem. & Mfg.
Huggins Labs.
Inst. Development Labs.
Kahl Scientific Inst.
Laboratory Equip. Corp.
Macalaster Bicknell
Mann Co., W. I.
Microchemical Service
Phoenix Prec. Inst.
Stoelting Co., C. H.
Thermal Syndicate, Ltd.
Ultra-Violet Products
Uhrig Co., Joseph
Unertl Optical Co.

### APPARATUS, Laboratory Glass

Ace Glass Inc.
Aloe Co., A. S.
American Inst. Co.
Applied Research
Belco Laboratory
Boehmke Optical Co.
Boekel & Co.
Burrell Tech. Supply
Central Scientific Co.
Century Geophysical
Chemical Rubber Co.

(Continued)

Chicago Apparatus Co.
Clay-Adams Co.
Corning Glass Works
Crystal Glass Tube
Distillation Products
Doerr Glass Co.
Eck & Krebs
Electronic Products
Fassett Co.
Ferguson Co.
Fischer & Porter
Fish-Schuman Co.
Fisher Scientific Co.
Flett Laboratory
Freas Glass Works
Fredericks Co., Geo.
General Biological
Glass Engg. Labs.
G. M. Mfg. Co.
Goetze Niemer Co.
Griebel Co.
Howe & French, Inc.
Huggins Labs.
Industrial Timer
Kahl Scientific Inst.
Kimble Glass Co.
Kontes Glass Co.
Laboratory Equip. Co.
Laboratory Materials Co.
Macalaster Bicknell
Machlett & Son
Mann Co., W. I.
Meyer Scientific Supply
Microchemical Service
Nester Co., Inc.
Palo-Myers, Inc.
Pfaltz & Bauer, Inc.
Philadelphia Therm. Co.
Phillips Petroleum
Phoenix Prec. Inst.
Podbielniak, Inc.
Precision Scientific Co.
Precision Thermometer
Process & Instruments
Rascher & Betzold
Refinery Supply
Rieker Inst. Co.
Robertson & Co., J. H.
Sargent & Co.
Schaar & Co.
Scientific Glass App.
Scientific Inst. Co.
Seedburo Equip. Co.
Specialty Glass Co.
Standard Science Sup.
Standard Scientific
Stoelting Co., C. H.
Tagliabue Div.
Technical Products
Tenney Engineering
Thomas Co., Arthur H.
Uhrig Co., Joseph
Universal X-Ray Prods.
Walker & Co., Geo. T.
Welch Scientific
Wilkens-Anderson Co.
Will Corporation

### AREA METERS (See Flow Meters, Area)

### ARTIFICIAL HORIZON (See also Aircraft Instruments)

Eastern Science Co.
Eclipse-Pioneer Div.
General Elec. Co.
Reeves Instrument
Schwien Engg. Co.
Sperry Gyroscope Co.
Summers Gyroscope

### ASPHALT PENETRATION NEEDLES (See Needles Asphalt Penetration)

### ASPHALT TESTING APPARATUS (See Testers, Asphalt)

### ASTRONOMICAL INSTRUMENTS

Bausch & Lomb
Berger & Sons
Clark & Sons
Dome Precision
Eastern Science Co.
Eclipse-Pioneer Div.
Fecker, Inc.
Gaertner Scientific Corp.
Henson Co., Fred C.
Lenox Inst. Co.
Mann Co., W. I.
Mico Instrument Co.
Mogey & Sons
Perkin-Elmer Corp.
Palos Optical Co.
Schwien Engr.
Taylor Inst. Cos.
Tinsley Labs.
Unertl Optical Co.
Warren-Knight Co.
White Co.
Carl Zeiss, Inc.

### ATTENUATORS

Audio Instrument
Centralab Div.
Cinema Engr.
Clarke Inst. Co.
Clarostat Mfg. Co.
Daven Co.
Electro Products Lab.
Feiler Engineering
General Radio Co.
Harvey Radio Labs.
Hewlett-Packard Co.
Hickok Electrical Inst.
International Resistance
Kay Electric Co.
Leeds & Northrup
Mallory & Co.
Measurements Corp.
Ohmite Mfg. Co.
Polytechnic Res. & Dev.
RCA Div.
Reiner Electronics
Scott, Inc., Hermon

(Continued)

Servo Corp. of America
Servomechanisms, Inc.
Shallcross Mfg. Co.
Sherron Metallic
Sound Apparatus
Sperry Gyroscope Co.
Trimount Inst. Co.

### AUDIO-FREQUENCY EQUIPMENT

Airdesign, Inc.
Allied Radio Corp.
American Communications
Amplifier Co.
Assembly Products
Audio Development Co.
Audio Instrument
Audio-Tone Oscillator
Baird Associates
Ballantine Labs.
Bark's Mfg. Co.
Beam Instrument
Berkeley Scientific
Boonton Radio Corp.
Browning Labs.
Brush Development
Century Geophysical
Cinema Engr.
Clark Radio Equip.
Clarke Inst. Corp.
Clarkstan Corp.
Clough Brengle Co.
Collins Radio Co.
Commercial Research
Concord Radio Corp.
Daven Co.
Eclipse-Pioneer Div.
Edin Electronics
Electro-Mech. Research
Electro-Medical Lab.
Electro Products Lab.
Electronic Design Corp.
Electronic Dev. Lab.
Electronic Prod. Co.
El-Tronics, Inc.
Engineering Res. & Dev.
Fairchild Camera
Federal Telephone
Feiler Engineering
Freed Transformer
General Elec. Co.
General Radio Co.
Geophysical Inst. Co.
Globe Phone Mfg. Co.
Hathaway Inst. Co.
Harvey Radio Labs.
Heiland Research
Hewlett Packard Co.
Hickok Elec. Inst. Co.
Jackson Elec. Inst.
Kalbfell Labs., Inc.
Kay Electric Co.
Lear, Inc.
Lewyt Metal Prod.
MacLeod & Hanopol
Martin-Hubbard Corp.
Massa Laboratories
McFarlin Co.
Measurements Corp.
Mellaphone Corp.
Metron Instrument
Millen Mfg. Co.
Minnesota Electronics
National Co.
Polarad Electronics
Premier Crystal Labs.
Radio Receptor Co.
Rauland Borg Corp.
Raytheon Mfg. Co.
RCA Div.
Reiner Electronics
Scott, Inc., Hermon
Shallcross Mfg. Co.
Sherron Metallic
Sound Apparatus
Southwestern Ind. Elec.
Standard Transformer
Sylvania Elec. Prod.
Technology Instrument
Televiso Co.
Thordarson Elec. Co.
Triumph Mfg. Co.
United Sound Eng. Co.
United Transformer Corp.
Westinghouse Elec.

### AUDIO-FREQUENCY OSCILLATORS (See Oscillators, Audio-Frequency)

### AUDIOMETERS

Marconi Insts. Ltd.
Scott, Inc., H. H .
Stoelting Co., C. J.

### AUTOCLAVES, High-Pressure

American Instrument
Parr Instrument
Precision Scientific
Ruska Inst. Corp.

### AUTO-COLLIMATORS

Acme Industrial
American Inst. Co.
Clark & Sons
Dome Precision
Dusenberg Co.
Engis Equipment
Farrand Optical
Fecker, J. W.
Gaertner Scientific
Geophysical Inst. Co.
Jarrell-Ash Co.
Kollmorgen Optical Co.
Mann Co., W. I.
Optical Ser. & Dev.
Palos Optical Co.
Perkin-Elmer Corp.
Unertl Optical Co.

### AUTOMATIC (See Controllers or Regulators)

### AUTOMOTIVE SERVICE INSTRUMENTS

Airdraulics Engineering
Bacharach Indus. Inst.
Bear Mfg. Co.
Cambridge Inst. Co.
Cole Instrument

(Continued)

Electric Heat Control
Engelhard, Chas.
Engineering Res. & Dev.
Fox Valley Inst.
Hays Corp.
Hickok Elec. Inst. Co.
Kimble Glass
Lewis Engineering
Niehoff & Co.
Potter Co.
Rieker Inst. Co.
Shauer Mfg. Co.
Scott, Inc., Hermon
Triplett Elec. Inst.
Westberg Mfg. Co.
Westinghouse Elec.
Weston Elec. Inst. Corp.

### AVIATION INSTRUMENTS, see also Aircraft; Inclinometers, Lateral; Indicators, Pitch & Bank; Chambers, Test & Calibration, etc.

Abrams Inst. Co.
Aero Electronics
Aeromarine Inst. Co.
Aeroequip Corp.
Aircraft Indicators Co.
Airdraulics Engineering
American Meas. Inst.
American Paulin System
Bailey Meter Co.
Boonton Radio Corp.
Coleman Instrument
Cook Electric
Daco Machine & Tool
De Jur-Amsco Corp.
Doelcam Corp.
Eclipse-Pioneer Div.
Edison Inc., Thomas A.
Federal Telegraph Co.
Fischer & Porter
Flight Research Eng.
Gadgets, Inc.
General Elec. Co.
Giannini & Co., G. M.
Guardian Elec. Mfg.
Ideal Lab. Tool
Jadur Import
Kollsman Inst. Div.
Lackner Co.
Lewis Engineering
Machlett & Son
Maxson Corp.
North Amer. Inst. Co.
Reeves Instruments
Revere Corp.
Rochester Mfg. Co.
Schwien Eng.
Sperry Gyroscope Co.
Standard Products Inc.
Summers Gyroscope
Televiso Co.
Trimount Inst. Co.
Triplett Elec. Inst.
U. S. Gauge
Wallace & Tiernan
Westinghouse Elec.
Weston Elec. Inst.
Wheelco Instruments
White & Co., David
Wiancko Engineering
Winslow Co.

### AZIMUTH INSTRUMENTS

Bliss & Co.
Dusenbery Co.
Eastern Science Co.
Eastern Specialty Co.
Fecker, J. W.
Flight Research Eng.
Gaertner Scientific Corp.
Hand & Sons
Keuffel & Esser Co.
Kollmorgen Optical Co.
Lear, Inc.
Leupold & Stevens
Negus, T. S. & J. D.
Ritchie & Son
Stafford Co.
Summers Gyroscope
Unertl Optical Co.
Warren-Knight Co.
White Co.

### BALANCES (See also object of measurement and control)

### BALANCES, Analytical

Ainsworth & Sons
Becker Div., Christian
Central Scientific Co.
Chicago Apparatus Co.
Dietert Co.
Exact Weight Scale Co.
Fisher Scientific Co.
Heusser Instrument
Jarrell-Ash Co.
Microchemical Service
Pfaltz & Bauer, Inc.
Roller-Smith
Seedburo Equipment
Seederer-Kohlbusch, Inc.
Thomas Co., Arthur H.
Thompson Balance
Troemner, Henry
Voland & Sons
Welch Scientific

### BALANCES, Assay

Ainsworth & Sons
Central Scientific Co.
Exact Weight Scale
Heusser Instrument
Jarrell-Ash Co.
Roller-Smith
Seederer-Kohlbusch, Inc.
Thompson Balance
Troemner, Henry
Voland & Sons

### BALANCES, Automatic Recording

Engineering Res. & Dev.
Roller-Smith
Taller & Cooper
Seederer Kohlbush, Inc.
Voiand & Sons

### BALANCES, Bullion

Becker Div., Christian
Exact Weight Scale
Seederer-Kohlbusch, Inc.
Troemner, Henry
Voland & Sons, Inc.

### BALANCES, Gas Density

Central Scientific Co.
Exact Weight Scale Co.
Hagan Corp.

Refinery Supply Co.
Thomas Co., Arthur H.

### BALANCES, Hydrostatic

Central Scientific Co.
Chicago Apparatus Co.
Seederer-Kohlbusch, Inc.

### BALANCES, Jewelers

Becker Div., Christian
Roller-Smith
Seederer-Kohlbusch, Inc.
Troemner, Henry
Voland & Sons, Inc.

### BALANCES, Joly's

Central Scientific Co.
Eberbach & Son
Welch Scientific

### BALANCES, Magnetic

Exact Weight Scale
Geophysical Inst. Co.
Instrument Lab., Inc.
Seederer-Kohlbusch, Inc.
Voland & Sons

### BALANCES, Magnetic (Geophysical)

Century Geophysical
Edin Electronics
Geophysical Inst. Co.
Ruska Inst. Corp.

### BALANCES, Micro

Ainsworth & Sons
Becker Div., Christian
Cady & Co., E. J.
Canadian Radium
Central Scientific Co.
Heusser Instrument
Microchemical Service
Mittelman Electronics
Pfaltz & Bauer, Inc.
Thomas Co., Arthur H.
Voland & Sons, Inc.

### BALANCES, Precision for Weights & Measures

Ainsworth & Sons
Becker Div., Christian
Burke & James
Cady & Co., E. J.
Central Scientific Co.
Chatillon & Sons
Coleman Inst. & Mfg.
Exact Weight Scale Co.
Heusser Instrument
W. & L. E. Gurley
Jacobs Bros. Co.
Ohaus Scale Co.
Pfaltz & Bauer, Inc.
Roller-Smith
Seedburo Equipment
Seederer-Kohlbusch, Inc.
Thompson Balance
Troemner, Henry
Voland & Sons, Inc.
Welch Scientific Co.

### BALANCES, Pulp

Becker Div., Christian
Central Scientific Co.
Exact Weight Scale
Heusser Instrument
Jacobs Bros. Co.
Seederer Kohlbush, Inc.
Thompson Balance
Troemner, Henry
Thwing-Albert Inst. Co.
Voland & Sons, Inc.
Williams Apparatus Co.

### BALANCES, Specific Gravity

Baird Associates
Becker Div., Christian
Burrell Tech. Supply
Central Scientific
Chicago Apparatus Co.
Eberbach & Son
Exact Weight Scale Co.
Fisher Scientific
Heusser Instrument
Humboldt Mfg. Co.
Ohaus Scale Corp.
Pfaltz & Bauer, Inc.
Refinery Supply
Ruehfel Co.
Seederer-Kohlbusch, Inc.
Thomas Co., Arthur H.
Troemner, Henry
Welch Scientific

### BALANCES, Surface Tension

Central Scientific Co.
Roller-Smith Co.
Seederer-Kohlbusch, Inc.
Torsion Balance Co.

### BALANCES, Triple Beam

Central Scientific
Dietert Co., Harry W.
Exact Weight Scale Co.
Fisher Scientific Co.
Ohaus Scale Corp.
Seedburo Equipment
Seederer Kohlbush, Inc.
Troemner, Henry
Welch Scientific

### BALANCES, Volumetric Flask

Becker Inc., Christian
Seederer Kohlbush, Inc.

### BALANCES, Westphal

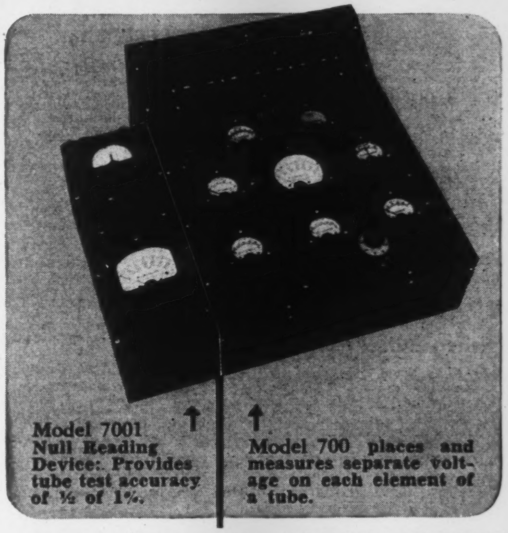
Becker Div., Christian
Central Scientific Co.
Chicago Apparatus Co.
Fisher Scientific
Pfaltz & Bauer, Inc.
Troemner, Henry

HICKOK

*Laboratory*

TUBE TESTER

ALL VOLTAGES VARIABLE AND METERED



Model 7001 Null Reading Device: Provides tube test accuracy of ½ of 1%.

Model 700 places and measures separate voltage on each element of a tube.

TESTS TUBES PER MANUFACTURERS MANUALS AND JAN SPECIFICATIONS

Designed for precise laboratory measurement of the most important vacuum tube characteristic, Transconductance (Mutual Conductance).

This new instrument places a separate voltage on each element of the tube. These voltages can be varied and measured by means of separate variable rheostats and meters in each circuit. AC ripple has been completely filtered out of the plate, screen and grid circuits.

Invaluable for development and research work in studying the behavior of various tubes when used in non-conventional and special circuits.

Model 7002 SHORT AND LEAKAGE TESTING

The complete short test is provided in a separate instrument to remove possible cause of oscillation. Permits adjustment for regulating sensitivity of indicator and voltage applied between all elements.

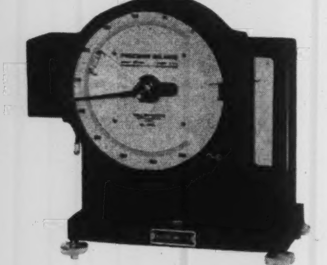
OTHER HICKOK LABORATORY MODELS

MODEL 539-A, ENGINEERS PORTABLE
Provides choice of 3 AC signals, 0.25, 0.5 and 2.5 volts.
Separate AC meter measures line voltage at all times.
Separate voltmeter measures grid bias.

MODEL 538-A, ENGINEERS PORTABLE
Has built in 20,000 ohm per volt DC multimeter.

Write for complete information today.

THE HICKOK ELECTRICAL INSTRUMENT CO.
10519 Dupont Avenue • Cleveland 8, Ohio



Make your tedious weighing job

*Simple and Routine with*
*Roller-Smith*

**PRECISION BALANCES**

**SAVE TIME—SAVE MONEY**

**IN ASSAYING — RESEARCH — PRODUCTION CONTROL—ANALYTICAL WORK**

*In the Manufacture of*

**Chemicals - Textiles - Lamp Filaments - Radio Tubes - Explosives - Watches - Paints - Biologicals**

The **Roller-Smith Precision Balance** is universally used for weighing within the range of 3 mg to 150 grams. Everyday applications include the measurement of liquid surface tension, yarn numbering, counting extremely small parts by weight, assaying precious ores, weighing diamonds and specific gravity determinatons.

The **Roller-Smith Precision Balance** is the result of careful research and painstaking design to produce a better means for *rapid weighing, quality control* and *uniformity* in the manufacture of your products.

. . . . . .

The **Roller-Smith Precision Balance** is backed by over *40 years of research and development experience* in the engineering of fine products. Let **Roller-Smith** help you with your weighing problems.

Write now for the
**Roller-Smith Precision Balance Catalog.**

**ROLLER-SMITH**
**CORPORATION**
**BETHLEHEM, PA.**

ROLLER SMITH

**BALANCING MACHINES, Dynamic**
Aero Electronics
Annis Co.
Bear Mfg. Co.
Electronic Corp.
Exact Weight Scale
Ferner Co.
General Elec. Co.
Gisholt Machine Co.
Globe Tool & Engg.
Lion Mfg., Inc.
Minnesota Electronics
Olsen Testing Machine
Westinghouse Elec.

**BALANCING MACHINES, Static**
Anderson Bros. Mfg. Co.
Annis Co.
Best Mfg. Co.
Commerce Pattern Fdry.
Exact Weight Scale
Ferner Co.
Gisholt Machine Co.
Gelber, Saml. S.
Globe Tool & Engg.
Olsen Testing Machine
Sundstrand Machine Tool
Taylor Dynamometer
Toledo Scale Co.

**BALLISTIC INSTRUMENTS, Crime Detection (See Microscopes, Ballistic Comparison)**

**BALLISTIC INSTRUMENTS, Electrical**
Berkeley Scientific
Cambridge Inst. Co.
Cole Instruments
General Elec. Co.
Gulton Mfg.
Jacobs Instruments
Kay Electric Co.
Leeds & Northrup Co.
Potter Instrument
Precision Ther. & Inst.
Rawson Electrical Inst.
Rubicon Co.
Sensitive Research Inst.
Triplett Elec. Inst.
Walkirt Co.
Westinghouse Elec.

**BALLISTIC INSTRUMENTS, Ordnance**
Bausch & Lomb Opt.
Berkeley Scientific
Cambridge Inst. Co.
Jacobs Instruments
Kay Electric Co.
Maxson Corp.
Potter Instrument
Precision Therm. & Inst.
Rawson Elec. Inst. Co.
Reeves Instrument
Rutishauser Corp.

**BANK & TURN INDICATORS**
Aeromarine Inst. Co.
Burton Mfg. Co.
Doelcam Corp.
Eclipse-Pioneer Div.
General Electric
Ideal Lab. Tool
Schwien Engineering
Summers Gyroscope

**BANK & TURN INDICATOR TESTERS**
Parks Co., Harry S.
Schwien Engineering Co.
Standard Products Inc.

**BARKOMETERS**
Central Scientific Co.
Kahl Scientific Inst.
Freas Glass Works
Fleischhauer & Son
G. M. Mfg. Co., Inc.
Griebel Co.
H-B Inst. Co., Inc.
Moeller Instrument Co.
Precision Therm. & Inst.
Ruehfel Co.
Schultheis Corp.
Tagliabue Div.
Taylor Inst. Cos.
Weksler Thermometer

**BAROGRAPHS (See Barometers, Recording)**

**BAROMETERS, Altitude**
Aeromarine Inst., Co.
Am. Paulin System
Bowen & Co.
Bruning Co.
Eclipse-Pioneer Div.
Flader Inc., Fredric
Friez Instrument
Green, Henry J.
H & H Thermostats
Hass Bros. Inst.
Ideal Lab. Tool
Instruments Corp.
Kenyon Instrument Co.
Keuffel & Esser Co.
Kollsman Inst. Div.
Mine Safety App. Co.
Panoramic Radio Co.
Post Co.
Precision Thermometer
Stratex Instrument Co.
Taylor Inst. Cos.
Technicraft Engg.
Thwing-Albert Inst. Co.
Wallace & Tiernan
Warren Knight Co.
Welch Scientific
Westinghouse Elec.
White Co.
Wiancko Engineering

**BAROMETERS, Aneroid**
Am. Paulin System
Central Scientific Co.
Eclipse-Pioneer Div.
Fisher Scientific
Friez Instrument
Instruments Corp.

(Continued)

Kenyon Instrument Co.
Keuffel & Esser Co.
Kollsman Inst. Co.
Mine Safety App. Co.
Negus, T.S. & J.D.
Post Co.
Precision Instrument
Scientific Inst. Co.
Serdex, Inc.
Standard Thermometer
Stewart, M. C.
Taylor Inst. Cos.
Testrite Instrument Co.
Wallace & Tiernan
Warren Knight Co.
White Co.

**BAROMETERS, Mercurial**
Alpha Instrument Co.
Builders-Providence
Central Scientific Co.
Chicago Apparatus Co.
Dietert Co.
Eberbach & Son
Eclipse-Pioneer Div.
Fisher Scientific Co.
Friez Instruments
Gaertner Scientific
Green, Henry J.
Hass Bros. Inst.
Ideal Lab. Tool
Instruments Corp.
Kessler Co.
Manning, Maxwell & Moore
Moeller Instrument Co.
Negus, T.S. & J.D.
Precision Thermometer
Sargent & Co.
Scientific Inst. Co.
Specialty Glass Co.
Standard Science Sup.
Stoelting Co.
Tagliabue Div.
Taylor Inst. Cos.
Trimount Inst. Co.
Uehling Instrument Co.
Universal X-Ray Prods.
Wallace & Tiernan
Weksler Thermometer
Welch Scientific

**BAROMETERS, Recording**
Alden Products
Alfax Paper
Am. Paulin System
Bacharach Ind. Inst.
Bristol Co.
Brown Inst. Div.
Foxboro Co.
Friez Instrument
Green, Henry J.
Hathaway Instrument
H & H Thermostats
Ideal Lab. Tool
Impact Register
Instruments Corp.
Kenyon Instrument Co.
Keuffel & Esser Co.
Serdex, Inc.
Taylor Inst. Cos.
Uehling Instrument Co.

**BAROMETERS, Station**
American Paulin
Friez Instrument
Green, Henry J.
Ideal Lab. Tool
Kollsman Inst. Div.
Manning, Maxwell, Moore
Precision Thermometer
Universal X-Ray Prods.
Wallace & Tiernan

**BAROMETRIC PRESSURE INDICATORS**
Am. Paulin System
Bristol Co.
Electronic Products
Foxboro Co.
Friez Instrument
Ideal Lab. Tool
Instrument Corp.
Kenyon Instrument Co.
Keuffel & Esser Co.
Kollsman Div.
Manning, Maxwell & Moore
Meriam Inst. Co.
Pioneer Inst. Co.
Precision Thermometer
Serdex, Inc.
Statham Labs.
Tagliabue Div.
Taylor Inst. Cos.
Uehling Instrument Co.
Wallace & Tiernan
Warren Knight Co.

**BAROMETRIC PRESSURE RECORDERS (See Barometers, Recording)**

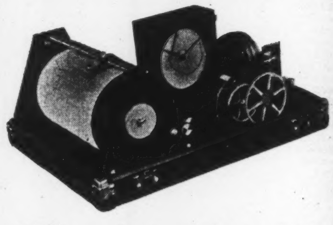
**BATHS, Calibrating**
American Inst.
Bowser Inc.
Braun Corp.
Process & Instruments
Ruska Inst. Corp.
Tenney Engr.

**BATTERIES, Dry**
Burgess Battery Co.
Kellogg Switchboard
Magnavox Co.
Mallory and Co.
National Carbon
RCA Div.
Specialty Battery
Walker-Jimieson, Inc.

**BATTERY CHARGERS**
American Communications
Automatic Elec. Chicago
Control Corp.
Cutler-Hammer, Inc.
Eclipse-Pioneer Div.
Electrical Facilities, Inc.
Electric Heat Control
Electronic Instrument
Federal Telephone
Ferranti Electric, Inc.
General Electric Co.
Kellogg Switchboard
Mallory & Co.
Radio Receptor Co.

(Continued)

MICRO
BAROGRAPH



24-hour chart reads to 0.001 inch mercury or the nearest one foot altitude.

- ACCURATE
- DEPENDABLE
- PORTABLE

Also
ALTIMETERS
BAROMETERS

*Send for Catalog*

**AMERICAN PAULIN SYSTEM**
**1847 So. Flower St.,**
**Los Angeles 15, Calif.**

Schauer Mfg. Co.
Sorenson & Co.
Standard Transformer
Ward Leonard Electric Co.
Westinghouse Elec.

**BATTERY ELIMINATORS**
American Communications
Assembly Products
Automatic Elec. Chicago
Consolidated Engg.
Electro Products Labs.
Electronic Prod. Co.
Electronic Instrument
Federal Telephone
General Electric Co.
General Radio Co.
Hagan Corp.
Kellogg Switchboard
Mallory & Co.
National Time & Signal
RCA Div.
Schauer Mfg. Co.
Standard Electric Time Co.
Standard Transformer

**BATTERY TESTERS (See Testers, Battery)**

**BEAM COMPASSES (See Drawing Instruments)**

**BEARING CIRCLES**
Alpha Instrument Co.
Dusenbery Co.
Eastern Specialty Co.
Geophysical Inst. Co.
Kollmorgen Optical Co.
Negus, T. S. & J. D.
Ritchie & Son

**BEARING TESTERS (See Testers Bearing)**

**BEATING TESTERS (See Testers, Beating)**

**BELLOWS, METALLIC**
Aeromarine Inst. Co.
Askania Regulator Co.
Bridgeport Thermostat Div.
Chicago Metal Hose
Clifford Mfg. Co.
Cook Electric Co.
Fulton Sylphon Div.
Hammel-Dahl Co.
Summers Gyroscope

**BENCHES, Optical**
Baird Associates
Bausch & Lomb
Cambridge Inst. Co.
Central Scientific Co.
Chicago Apparatus Co.
Fuess, Inc.
Gaertner Scientific Corp.
Geophysical Inst. Co.
Jarrell-Ash Co.
Mico Instrument Co.
Optical Service & Dev.
Carl Zeiss, Inc.

**BEVEL PROTRACTORS (See Drawing Instruments)**

**BIN LEVEL INDICATOR (See Controllers, Automatic, Granular Material Level)**

**BINNACLES (See Nautical Instruments)**

**BINOCULARS**
Alpha Instrument Co.
Am. Telescope Labs.
Bausch & Lomb Optical
Bray Optical Co.
Clark & Sons
Dome Precision
Eclipse-Pioneer Div.
Fecker, Inc.
Kollsman Inst. Div.
Mogey & Sons
Negus, T.S. & J.D.
Palos Optical Co.
Testrite Instrument Co.
Unertl Optical Co.
Warren Knight Co.
White Co.
Wollensak Optical Co.

**BINOCULARS, Polarizing, Variable Density, etc.**
Polarizing Inst. Co.
Unertl Optical Co.

**BLAST METER (See Flow Meters, Blast)**

**BLOCKS, Terminal**
Ahrendt Instrument
Cinema Engr.
Cole Instrument
Lewis Engineering
States Co.

**BOLOMETERS**
Baird Associates
Ballantine Labs.
Cambridge Inst. Co.
Eppley Laboratory
Farrand Optical
MacDonald Co.
Sperry Gyroscope Co.

**BOMBS, High pressure for testing bottom hole samples, Oil & Gas**
American Inst. Co.
Hoke, Inc.
Koehler Instrument
Precision Scientific
Refinery Supply Co.
Ruska Inst. Co.

**BOMBS, Hydrogenation**
American Inst. Co.
Autoclave Engineers
Parr Instrument Co.
Precision Scientific
Ruska Inst. Corp.

**BOMBS, Lean Oil**
Daniel Orifice Fitting
Parr Instrument
Precision Scientific

**BOMBS, Micro Combustion**
Autoclave Engineers
Microchemical Service
Parr Instrument Co.
Precision Scientific

**BOMBS, Oxygen**
Parr Instrument Co.
Precision Scientific
Scott Co., Henry L.

**BOMBS, Reid Vapor Pressure**
American Inst. Co.
Central Scientific Co.
Daniel Orifice Fitting
Koehler Instrument
Precision Scientific Co.
Refinery Supply Co.
Tagliabue Div.

**BOMBS, Sodium Peroxide**
Parr Instrument Co.

**BOMBS, Specific Gravity**
Central Scientific Co.
Daniel Orifice Fitting
Refinery Supply Co.

**BOMBS, Sulpur**
Central Scientific Co.
Parr Instrument Co.
Refinery Supply

**BOMBS, Temperature**
Ruska Inst. Corp.
Shand & Jurs Co.
Vapor Recovery Systems

**BORE INSPECTION INSTRUMENTS (See Telescopes, Bore, (Inspection)**

**BOTTLES, Cubic Foot**
American Meter Co.
Central Scientific Co.
Fish-Schurman Co.
Precision Scientific Co.
Superior Meter Co.

**BOTTLES, Specific Gravity**
Ace Glass Inc.
American Meter Co.
Bellco Glass, Inc.
Central Scientific Co.
Chicago Apparatus Co.
Corning Glass Works
Fish-Schurman Co.
Fisher Scientific Co.
Kimble Glass Co.
Kontes Glass Co.
Podbielniak, Inc.
Scientific Glass App.
Specialty Glass Co.
Standard Science Sup.
Vapor Recovery Systems
Welch Scientific

**BOTTLES, Weighing**
Ace Glass, Inc.
Bellco Glass, Inc.
Central Scientific Co.
Chicago Apparatus Co.
Fish-Schurman Co.
Fisher Scientific Co.
Kimble Glass Co.
Kontes Glass Co.
Microchemical Service
Podbielniak, Inc.
Scientific Glass App.
Specialty Glass Co.
Standard Science Sup.
Uhrig Co., J. F.
Welch Scientific

**BOXES, Aytron Shunt**
Eastern Specialty
Fisher Scientific
Leeds & Northrup
Rubicon Co.
Shallcross Mfg. Co.
Winslow Co.

**BOXES, Ratio**
Associated Research
Brown Electro-Measurement
Calidyne Co.
Cambridge Inst. Co.
Cinema Engr.
Cole Instrument
Daven Co.
Fischer & Porter
General Radio Co.
Leeds & Northrup
Rubicon Co.
Sensitive Research Inst.
Shallcross Mfg. Co.
Winslow Co.

**BOXES, Resistance**
Associated Research
Automatic Elec. Chicago
Berkshire Laboratories
Brown Electro-Measurement
Bunnell Co., J. H.
Cambridge Inst. Co.
Central Scientific
Chicago Apparatus Co.
Cinema Engr.
Clough Brengle Co.
Cole Instrument
Cutler-Hammer, Inc.
Daven Co.
Electronic Dev. Lab.
General Radio Co.
Leeds & Northrup
Muter Company
Ohmite Mfg. Co.
Radio City Products
Reiner Electronics
Rubicon Co.
Sensitive Research Inst.
Shallcross Mfg. Co.
Thwing-Albert Inst. Co.
Triumph Mfg. Co.
Welch Mfg. Co.

**BOXES, Thermostat**
Process & Instruments
Thwing-Albert Inst. Co.
Winslow Co.

**BRAKE TESTING METER (See Testers and Testing Machines, Brake)**

**BRIDGES, ELECTRICAL, A-c.**
Aerovox Corp.
Associated Research
Baldwin-Lima-Hamilton
Brown Electro-Measurement
Cambridge Inst. Co.
Clough-Brengle Co.
Cole Instrument
Consolidated Engg.
Daven Co.
Electronic Dev. Lab.
Electronic Prod. Co.
El-Tronics Co.
Feiler Engineering
Freed Transformer
General Elec. Co.
General Radio Co.
Gray Instrument
Leeds & Northrup Co.
Loudon Insts.
Radio City Products
Reiner Electronics
Rubicon Co.
Shallcross Mfg. Co.
Sherron Metallic
Technology Instrument
Tobe Deutschmann Corp.
United Transformer

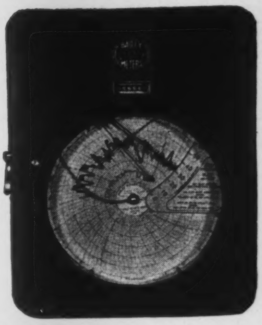
**BRIDGES, ELECTRICAL Capacitance**
Aerovox Corp.
Associated Research
Brown Electro-Measurement
Brush Development
Cambridge Inst. Co.
Central Scientific Co.
Clippard Inst. Lab.
Clough Brengle Co.
Cole Instrument
Communication Meas. Lab.
Electronic Dev. Lab.
Electronic Instrument
Feiler Engineering
Freed Transformer
General Elec. Co.
General Radio Co.
Gray Instrument
Industrial Inst. Inc.
Jackson Electrical Inst.
Kalbfell Labs., Inc.
Leeds & Northrup Co.
Measurements Corp.
Rubicon Co.
Sherron Metallic
Solar Mfg. Corp.
Sylvania Elec. Prods.
Tobe Deutschmann Corp.
Triplett Elec. Inst. Co.
Triumph Mfg. Co.

**BRIDGES ELECTRICAL Conductivity**
Aerovox Corp.
Associated Research
Cambridge Inst. Co.
Central Scientific Co.
Cole Instrument
Edin Electronics
Electro-Mec Lab.
Electronic Prod. Co.
Feiler Engineering
Freed Transformer
General Electric
Gray Instrument
Industrial Inst. Inc.
Klett Mfg. Co.
Leeds & Northrup Co.
Rubicon Co.
Shallcross Mfg. Co.
Sherron Metallic
Thwing-Albert Inst. Co.

**BRIDGES, ELECTRICAL D-c.**
Associated Research
Baldwin-Lima-Hamilton
Clippard Inst. Lab.
Cole Instrument
Consolidated Engg.
Daven Co.
Edin Electronics
Electro-Mec Lab.
Electronic Dev. Lab.
El-Tronics, Inc.
Eppley Laboratory, Inc.
Feiler Engineering
Fisher Scientific
Freed Transformer
General Radio
Gray Instrument
Leeds & Northrup
Measurements Corp.
Radio City Products
Reiner Electronics
Rubicon Co.
Shallcross Mfg.
Sherron Metallic
Thwing-Albert Inst. Co.
Winslow Co.

**BRIDGES, ELECTRICAL Hoopes**
Cole Instrument
Freed Transformer
Gray Instrument
Leeds & Northrup Co.

(Continued)



BOILER METER

● This dependable and accurate guide to maximum combustion economy is easily understood and followed by operators. It indicates, records and integrates Steam Flow from the boiler, records Air Flow supplied for combustion, and records Flue Gas Temperature.

Best combustion efficiency is secured by keeping Steam Flow and Air Flow pens together so that the records coincide one upon the other. The record of flue gas temperature when compared with that of Steam Flow shows the condition of baffles and tubes, and indicates heat absorption efficiency.

The Bailey Steam Flow-Air Flow Boiler Meter reduces fuel costs, lessens maintenance and outage, lowers standby costs and adds capacity. It is suitable for boiler plants operating units of 100 h.p. or more fired with stokers, pulverized coal, gas, oil or other fuels.

In order to obtain the maximum benefit from the Bailey Boiler Meter, it should be made an integral part of a Bailey Combustion Control System so that combustion losses are automatically corrected for even as they tend to appear.

For further details, refer to Sweet's Engineering Catalog or send for a copy of bulletin No. 46.

BAILEY METER COMPANY
1041 IVANHOE ROAD · CLEVELAND, O.
Bailey Meter Company Ltd., Montreal, Canada

SPECIALTY OFFERS

LAB-BILT DRY BATTERIES
Standard or Custom-made

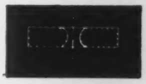
INDUSTRY
LABORATORY
RADIO AND IGNITION

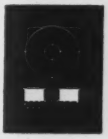
Write for FREE CATALOG
This catalog gives complete specifications of 78 Lab-Bilt Batteries of industrial and hard-to-get types.

CUSTOM-MADE BATTERIES
Battery Specification Sheet illustrated in catalog enables you to get any type dry battery designed and made to your individual specifications — even in small quantities!

SUPER SERVICE
Specialty Battery Company is specially equipped to make all Lab-Bilt Batteries FRESH for each order and ship immediately. Give your customers this valuable service. Write for a new catalog today.

SPECIALTY BATTERY COMPANY
A Subsidiary of the RAY-O-VAC Ray-O-Vac Company
MADISON 10, WISCONSIN





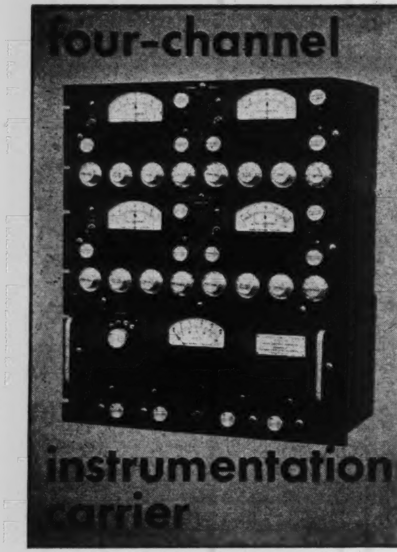
Bird
PRECISION
JEWEL BEARINGS
SAPPHIRE & GLASS

Performance proved for precision and long life by world's leading makers of *electrical, aircraft and timing instruments; compasses; weather recorders; all testing, indicating and recording apparatus.*

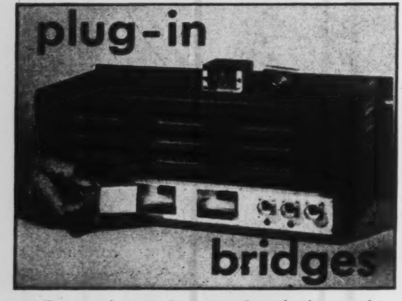
The engineering staff of the Bird Company is at your service for all small-bearing problems.

*Serving industry with fine jewels since 1913*

Richard H. Bird
&, Co., Inc.
1 Spruce St., Waltham 54, Mass.



For low-level measurements of stress, strain, displacement, pressure, temperature, velocity, acceleration. High gain, 30 µv input for 1-ma output; bandpass frequency response, 0 to 500 cps ± 2% flat. Automatic compensation for static zero drift of oscillograph traces permits truly unattended operation. Special stress-analysis calibration network allows direct reading of stress in steel.



Transducer inputs feed through thermally-insulated plug-in bridge circuits for 1-, 2-, and 4-legged configurations. Facilitates summing or difference-taking within transducer arrays through single amplifier channel. Low noise and exceptional stability under local electrical disturbance, temperature and humidity variation.
Send today for further data.

ELECTRONIC
ENGINEERING
ASSOCIATES, LTD.

1046-A Brittan Avenue
San Carlos, California

**BRIDGES, ELECTRICAL**
**Impedance**
Brown Electro-Measurement
Clarke Inst. Corp.
Cole Instrument
Daven Co.
Electronic Dev. Lab.
Feiler Engineering
Freed Transformer
General Elect. Co.
General Radio
Gray Instrument
Hewlett-Packard
Kalbfell Labs., Inc.
Leeds & Northrup
Radex Corp.
Scott, Inc., Hermon
Technology Instrument
Thwing-Albert Inst. Co.
Winslow Co.

**BRIDGES, ELECTRICAL**
**Inductance**
Associated Research
Brush Development
Cambridge Inst. Co.
Cole Instrument
Daven Co.
Electronic Dev. Lab.
Electronic Instrument
Feiler Engineering
Freed Transformer
General Elec. Co.
General Radio Co.
Gray Instrument
Industrial Instr., Inc.
Kalbfell Labs., Inc.
Leeds & Northrup Co.
Measurements Corp.
Raytheon Mfg. Co.
Rubicon Co.
Triumph Mfg. Co.
Winslow Co.

**BRIDGES, ELECTRICAL, Kelvin**
Associated Research
Beck Bros.
Cambridge Inst. Co.
Central Scientific
Cole Instrument
Electro Products Lab.
Eppley Laboratory
Feiler Engineering
Freed Transformer
General Elec. Co.
Gray Instrument
Industrial Inst. Inc.
Leeds & Northrup Co.
Rubicon Co.
Shallcross Mfg. Co.
Sticht Co.
Tagliabue Corp., C. J.
Thwing-Albert Inst. Co.
Winslow Co.

**BRIDGES, ELECTRICAL, Limit**
Associated Research
Clippard Inst. Lab.
Cole Instrument
Communication Meas. Lab.
Electro-Mec Lab.
Electronic Dev. Lab.
El-Tronics, Inc.
Feiler Engineering
Freed Transformer
Gray Instrument
Industrial Insts. Inc.
Leeds & Northrup
Radio City Products
Reiner Electronics
Rubicon Co.
Shallcross Mfg. Co.
Sticht Co.
Winslow Co.

**BRIDGES, ELECTRICAL, Megohm**
Associated Research, Inc.
Beck Bros.
Cambridge Inst. Co.
Clough Brengle Co.
Cole Instrument
Electronic Dev. Lab.
Electronic Instrument
Electro Products Lab.
Feiler Engineering
Freed Transformer
General Elec. Co.
General Radio Co.
Gray Instrument
Industrial Instruments
Leeds & Northrup Co.
RCA
Roller-Smith Co.
Rubicon Co.
Shallcross Mfg. Co.
Sticht Co., Herman
Triumph Mfg. Co.
Winslow Co.

**BRIDGES, ELECTRICAL, Power-Factor**
Cambridge Inst. Co.
Clough-Brengle Co.
Cole Instrument
Electronic Dev. Lab.
Electronic Instrument
General Electric Co.
General Radio Co.
Gray Instrument
Industrial Instruments
Leed & Northrup Co.

**BRIDGES, ELECTRICAL, Slide Wire**
Beck Bros.
Cambridge Inst. Co.
Central Scientific Co.
Cole Instrument
Electronic Dev. Lab.
Feiler Engineering
Industrial Insts. Inc.
Leeds & Northrup Co.
Meter Devices Co.
Roller-Smith Co.
Rubicon Co.
Shallcross Mfg. Co.
Sticht Co., Inc.
Tagliabue Div.
Thwing-Albert Inst. Co.
Welch Mfg. Co.

**BRIDGES, ELECTRICAL, Vacuum Tube**
Central Scientific Co.
Cole Instrument
Crown Ind. Prods.
Eclipse-Pioneer
Electronic Prod. Co.
Electro Products Lab.
El-Tronics, Inc.
Feiler Engineering
Fisher Scientific Co.
General Elec. Co.
General Radio Co.
Harvey Radio Labs.
Industrial Insts. Inc.
Lear, Inc.
RCA Manufacturing
Sylvania Elec. Prod.
Televiso Co.
Thwing-Albert Inst Co
Triumph Mfg. Co.
Wilson & Co.

**BRIDGES, ELECTRICAL, Wattmeter**
Aerovox Corp.
Freed Transformer Co.
Sperry Gyroscope Co.

**BRIDGES, ELECTRICAL Wheatstone**
Associated Research
Baldwin-Lima-Hamilton
Beck Bros.
Biddle Co., James
Borden Engineering
Brown Electro-Measurement
Cambridge Inst. Co.
Central Scientific Co.
Chicago Apparatus Co.
Cole Instrument
Communication Meas. Lab.
Daven Co.
Electronic Dev. Lab.
Electro-Mec Lab.
Electro Products Lab.
Electro-Tech. Equip.
Eppley Laboratory
Feiler Engineering
General Elec. Co.
General Radio Co.
Gray Instrument
Industrial Control
Industrial Inst. Inc.
Leeds & Northrup Co.
Loudon Insts.
Roller-Smith Co.
Rubicon Co.
Shallcross Mfg. Co.
Sticht Co.
Tagliabue Div.
Thwing-Albert Inst. Co.
Welch Mfg. Co.
Winslow Co.

**B.T.U. INDICATORS**
Central Scientific Co.
Cutler-Hammer Inc.
Hagan Corp.
Precision Scientific

**BURETTES**
Ace Glass Inc.
Burrell Tech. Supply
Central Scientific Co.
Electronics Products
Fish-Schurman Co.
Fisher Scientific Co.
G. M. Mfg. Co.
Griebel Co.
Hays Corp.
Kahl Scientific Inst.
Kimble Glass Co.
Kontes Glass Co.
Macalaster Bicknell Co.
Machlett & Son
Microchemical Service
Palo-Myers, Inc.
Podbielniak, Inc.
Rascher & Betzold
Robertson & Co., J. H.
Sargent & Co.
Scientific Glass App. Co.
Scientific Instr. Co.
Specialty Glass Co.
Welch Scientific

**CABIN PRESSURE CONTROLS (Aeroplane)**
AiResearch Div.
Eclipse-Pioneer Div.
Kollsman Instr. Div.
Lear, Inc.
Minneapolis-Honeywell
Robinette Co.
Schwien Engineering

**CABINETS, Test (See Chambers, Test)**

**CABLE TESTERS (See Testers, Cable)**

**CALIBRATING EQUIPMENT for Electrical Instruments & Meters**
Amer. Time Products
Associated Research, Inc.
Beck Bros.
Browning Labs.
Calidyne Co.
Cambridge Inst. Co.
Clippard Inst. Lab.
Cole Instrument
Commercial Research
Daven Co.
Eastern Specialty Co.
Electrical Facilities, Inc.
Electro-Tech. Equip
Electronic Associates
Electronic Dev. Lab.
Feiler Engineering
Ferranti Electric, Inc.
General Electric Co.
Gray Instrument Co.
Hathaway Instrument Co.
Heiland Research
Hewlett-Packard
Hickok Elec. Inst.
Industrial Electronics
Lavoie Laboratories
Leeds & Northrup Co.
Lewis Engineering
(Continued)
Marion Electrical Inst.
M. B. Mfg. Co.
Measurements Corp.
Nankervis Co., G. L.
National Tech. Labs.
Potter Instrument
Premier Crystal Labs.
Radio Frequency Labs.
Rawson Elec. Inst. Co.
RCA
Roller-Smith Co.
Rowe Engineering
Rubicon Co.
Rutherford Electronics
Sangamo Electric
Scott, Inc., Hermon
Sensitive Research Inst.
Shallcross Mfg. Co.
Sorenson & Co.
Sperry Gyroscope Co.
Standard Electric Time
Standard Products Inc.
Televiso Co.
Thwing-Albert Instrument
Walkirt Co.
Western Electro-Mech.
Weston Electrical Inst.

**CALIBRATING EQUIPMENT for Testing Machines**
American Meas. Inst.
Amer. Time Products
Baldwin-Lima-Hamilton
Cady & Co., E. J.
Commercial Research
Dillon & Co., Inc., W. C.
General Electric Co.
Hathaway Instrument Co.
Instruments Labs.
M. B. Mfg. Co.
Olsen Testing Machine
Pittsburgh Instrument
Riehle Testing Machine
Standard Products Inc.
Steel City Testing Mach.
Thwing-Albert Instrument

**CALIPER RULES**
American Meas. Inst.
Brown & Sharpe
DoAll Co.
Lufkin Rule Co.
Millers Falls Co.
Starrett Co., L. S.
Weber Co.
Welch Scientific
Zeiss. Inc., Carl

**CALIPERS, Indicating**
Alina Corp.
American Meas. Insts.
Ames Co., B. C.
Cady & Co., E. J.
DoAll Co.
Federal Products Corp.
Indicating Calipers Co.
Magnetic Gauge Co.
Sheffield Corp.
Starrett Co.

**CALIPERS, Inside & Outside**
American Meas. Inst.
Brown & Sharpe
DoAll Co.
Eitzen Co.
Farrell-Birmingham (Large for Rolls)
Federal Products Corp.
Glogau & Co.
Indicating Calipers Co.
Jansson Gage Co.
Lufkin Rule Co.
Maveg Machine Sales
Millers Falls Co.
Park Sales
Scherr Co., Inc.
Sheffield Corp.
Starrett Co.
Summers Gyroscope
Welch Mfg. Co.
Zeiss, Inc., Carl

**CALIPERS, Square**
DoAll Co.
Lufkin Rule Co.
Starrett Co.

**CALIPERS, Vernier**
Alina Corp.
American Meas. Insts.
Brown & Sharpe
Park Sales Co.
Starrett, L. S.

**CALORIMETERS, Adiabatic**
Bowen & Co.
Central Scientific
Emerson Apparatus Co.
Ever Ready Thermometer
Parr Instrument Co.

**CALORIMETERS, Coal & Fuel**
Central Scientific Co.
Emerson Apparatus Co.
Ever Ready Thermometer
Fisher Scientific
Parr Instrument Co.
Precision Therm
Welch Mfg. Co.
Wilkens-Anderson Co.

**CALORIMETERS, Gas**
American Meter Co.
Central Scientific Co.
Connelly, Inc.
Cutler-Hammer, Inc.
Ever Ready Thermometer
Hays Corp.
Precision Scientific Co.
Precision Thermometer
Refinery Supply Co.
Wilkens-Anderson Co.

**CALORIMETERS, Oxygen Bomb**
Central Scientific
Emerson Apparatus
Ever Ready Thermometer
Fisher Scientific
Parr Instrument Co.
Refinery Supply Co.

**CALORIMETERS, Peroxide Bomb**
Ever Ready Thermometer
Fisher Scientific
Parr Instrument Co.
Central Scientific

**CALORIMETERS, Steam**
Ellison Draft Gage Co.
Ever Ready Thermometer
Welch Scientific
Wilkens-Anderson Co.

**CAMERAS, Aerial**
Ahrams Instrument
Fairchild Camera & Inst.
Specialties Inc.
Vectron, Inc.

**CAMERAS, Microfilm**
Abrams Instrument
Bell & Howell
Bolsey Corp.
Burke & James
Eastman Kodak Co.
Graflex Corp.
Microstat Corp.

**CAMERAS, Oscilloscope Recording**
Berkshire Laboratories
Century Geophysical
Electro-Medical Lab.
Fairchild Camera & Inst.
Flight Research Engr.
General Radio
Midwestern Geophysical
Photographic Products
Rutishauser Corp.
Southwestern Ind. Elec.

**CAMERAS, SCIENTIFIC**
Abrams Instrument
Baird Associates
Bausch & Lomb Opt.
Beckman & Whitley
Burke & James
Cambridge Inst. Co.
Century Geophysical
Coleman Inst. & Mfg.
De Vry Corp.
DuMont Labs.
Eastman Kodak Co.
Electro-Medical Lab.
Fecker, Inc.
Flett Lab.
Flight Research Eng.
General Radio Co.
Graflex Corp.
Heiland Research
Jacobs Instruments
Jarrell-Ash Co.
Leitz, Inc.
Mico Instrument Co.
Perkin-Elmer Corp.
Process & Instruments
Rutishauser Corp.
Stoetting Co., C. J.
Warrick, Frederick
Zeiss, Inc., Carl

**CAMERAS, SCIENTIFIC Back Reflection**
Abrams Instrument
Bolsey Corp.
Farrand Optical
General Elec. X-Ray Dept.
Hayes Scientific App.
Leitz, Inc.
North Amer. Phillips
Picker X-Ray

**CAMERAS, SCIENTIFIC Diffraction (See X-Ray Cameras, Diffraction)**

**CAMERAS, SCIENTIFIC Motion Picture**
Abrams Instrument
Bell & Howell
Bolsey Corp.
Burke & James
De Vry Corp.
Eastern Science Co.
Eastman Kodak Co.
Flight Research Eng.
General Radio Co.
Geophysical Inst. Co.
Jacobs Instruments
Process & Instruments
Maurer, Inc.

**CAMERAS, SCIENTIFIC, Photo Micro (See Microscopes, Metallographic)**

**CAMERAS, SCIENTIFIC, Motion Pictures, High Speed**
Bell & Howell
Burke & James
General Radio Co.

**CAMERAS, Television**
Du Mont Labs., Inc.
General Electric
Jacobs Instruments
Perkin-Elmer Corp.
RCA Div.
Television Equipment

**CAPACITANCE METERS**
Aerovox Corp.
Biddle Co., Jas. G.
Boonton Radio
Cambridge Inst. Co.
Clough-Brengle Co.
Cole Instruments
Electronic Dev. Lab.
Feiler Engineering
Fielden Instrument
General Elec. Co.
General Radio Co.
Jackson Electrical Inst.
Kalbfell Labs. Inc.
Leeds & Northrup Co.
MacLeod & Hanopol
Panoramic Radio Co.
Premier Crystal Labs.
Radio City Products
Reiner Electronics
Rubicon Co.
Sickles Co.
Solar Mfg. Corp.
Sprague Electric Co.
Triplett Elec. Inst.
Wilson & Co.

Standard
CABINET COMPANY

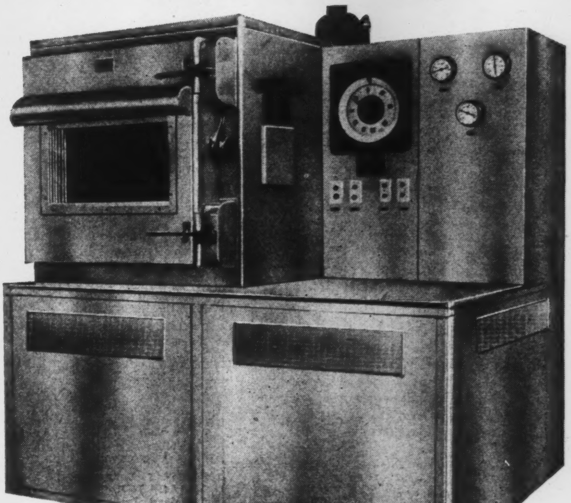
TEST CHAMBERS
High and Low Temperatures
Controlled Humidity

+ 200°F. to – 150°F.
20% to 95% R.H.
1 cu. ft. to 75 cu. ft. cabinets
Walk-in Rooms
Temperature Baths

Electronic or pneumatic recording
or indicating control systems

*CUSTOM CHAMBERS*
*built to specifications.*
*years of satisfactory service!*

Standard Cabinet Co.
52 Washington Avenue
CARLSTADT, N. J.



**CAPACITORS, Air**
Cambridge Inst. Co.
General Electric Co.
General Radio Co.
Johnson Co., E. F.
Leeds & Northrup Co.
Millen Mfg. Co.
North Amer. Philips

**CAPACITORS, Electrolytic**
Aerovox Corp.
American Condenser
Chicago Condenser
Cornell Dubilier
General Elec. Co.
Industrial Condenser
Magnavox Co.
Mallory & Co.
National Co.
Sangamo Electric
Solar Mfg. Corp.
Sprague Electric Co.
Tobe Deutschmann Corp.
Walker-Jamieson, Inc.
Westinghouse Elec.

**CAPACITORS, Mica**
Aerovox Corp.
Cambridge Inst. Co.
Cornell Dubilier
Centralab Div.
Crystal Research Labs.
General Elec. Co.
General Radio Co.
Industrial Inst., Inc.
Kellogg Switchboard
Leeds & Northrup Co.
Mallory & Co.
Measurements Corp.
National Co.
RCA
Rubicon Co.
Sangamo Electric Co.
Sickles Co.
Solar Mfg. Corp.
Sprague Electric Co.
United Condenser
Winslow Co.

**CAPACITORS, Paper**
American Condenser
Aerovox Corp.
Automatic Elec. Chicago
Chicago Condenser
Condenser Products
Cornell Dubilier
Electrical Utilities
Fast & Co., John E.
General Elec. Co.
General Radio Co.
Industrial Condenser
Kellogg Switchboard
Mallory & Co.
National Co.
Potter Co.
Sangamo Electrical Co.
Solar Mfg. Corp.
Sprague Electric Co.
Tobe Deutschmann Corp.

**CAPACITORS, Precision**
Aerovox Corp.
Brown Electro-Measurement
Cardwell Mfg. Co.
Centralab Div.
Condenser Products
Cornell Dubilier
Crystal Research Labs.
Fast & Co., John E.
General Elec. Co.
General Radio Co.
Gulton Mfg. Co.
Industrial Condenser
Leeds & Northrup Co.
MacLeod & Hanopol
Mallory & Co.
Millen Mfg. Co.
National Co.
Potter Co.
Sprague Electric Co.
Winslow Co.

**CAPACITORS, Variable**
Bud Radio, Inc.
Cambridge Inst. Co.
Centralab Div.
Clarke Inst. Corp.
Clippard Instrument
Crystal Research Labs.
Dittmore & Freimuth
Eitel-McCullough, Inc.
Engineering Research Ass.
General Elec. Co.
General Radio Co.
Harvey Radio Labs.
Johnson Co., E. F.
Kellogg Switchboard
Leeds & Northrup Co.
Measurements Corp.
Millen Mfg. Co.
National Co.
Oak Mfg. Co.
Rauland Corp.
Rubicon Co.
United Condenser

**CAPACITY METERS**
Aerovox Corp.
Bernard, H. J.
Bradshaw Instruments
Clough-Brengle Co.
Cole Instruments
Cornell Dubilier
General Elec. Co.
General Radio Co.
Hickok Elec. Inst. Co.
Industrial Inst. Co.
Kalbfell Labs., Inc.
Leeds & Northrup Co.
MacLeod & Hanopol
Premier Crystal Labs.
Radio City Products Co.
Rubicon Co.
Solar Mfg. Corp.
Sprague Electric Co.
Triplett Elec. Inst.
Weston Elec. Inst. Corp.
Yellow Springs Inst.

**CARBON DIOXIDE METERS (See Gas Analyzers, Carbon Dioxide)**

**CARBON MONOXIDE METERS (See Gas Analyzers. Carbon Monoxide)**

**CARBON PILES (See Resistors, Carbon Compression)**

**CATHETOMETERS**
Cambridge Inst. Co.
Central Scientific Co.
Dietert Co.
Eberbach & Son
Ferner Co.
Gaetner Scientific Corp.
Henson Co., Fred C.
Jarrell-Ash Co.
Mico Instrument Co.
Welch Scientific

**CATHODE RAY TUBES (See Oscillographs, Cathode Ray)**

**CELLS, Concentration**
Fish-Schurman Corp.
Leeds & Northrup Co.
Zeiss, Inc.

**CELLS, Conductivity, Electrical**
Allied Controls Co.
American Inst. Co.
Cambridge Inst. Co.
Central Scientific Co.
Coleman Electric Co.
Engelhard, Charles
Fisher Scientific Co.
Fredericks Co., George
Gray Instrument Co.
H-B Instrument
Industrial Instruments
Instrument Lab., Inc.
Klett Mfg. Co.
Leeds & Northrup Co.
Minnesota Electronics
Phoenix Prec. Inst.
Revere Co.
Sargent & Co.
Scientific Glass App.

**CELLS, Conductivity. Thermal**
Burrell Tech. Sup.
Cambridge Inst. Co.
Central Scientific Co.
Engelhard, Chas.
Fredericks Co., George
Gow-Mac Instrument Co.
Leeds & Northrup Co.
Victroy Engr.

**CELLS, Kerr**
Engelhard, Charles
General Physical Lab.
Precise Measurements Co.

ACCURACY OF TEMPERATURE CONTROL DETERMINES ITS QUALITY

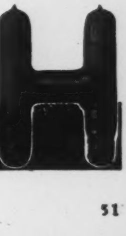
ACCURATE control of temperature or pH is vital to modern heat treating or chemical processing, because only in this way can uniform quality be obtained under mass production conditions.

Potentiometers have made such control possible, and "the heart" of these instruments in most cases, for over 25 years, has been the Eplab Standard Cell. This cell is a "yardstick" for the translation of voltage to temperature. The first commercial cell of its type, constant research has made it "as standard as sterling".

When you buy potentiometers, specify Eplab Standard Cells.

THE EPPLEY LABORATORY, INC.
*SCIENTIFIC INSTRUMENTS • NEWPORT, R. I., U. S. A.*

EPLAB Standard Cells For Potentiometric Instruments
As Standard as Sterling



TEMPERATURES? ATMOSPHERES? PRESSURES? for the finest in Test Chambers TEST WITH Tenney

Tenney has combined years of specialized experience with the most advanced engineering methods. Results have convinced industry that Tenney testing equipment is the finest available. For complete confidence, specify Tenney.

TENNEYZPHERE ALTITUDE CHAMBERS

Designed to withstand atmospheric pressure and to simulate global conditions of pressures, temperatures and humidities. Altitudes from sea level to approx. 75,000 ft. Temperature range from plus 200°F to minus 100°F. Also simulates desired relative humidity.

TENNEY SERVO UNIT

Portable air conditioning unit which may easily be attached to various types of laboratory enclosures—impact machines; tension machines; torsion testers; cold boxes and similar equipment. Through its use, articles undergoing testing, aging or weathering can be subjected to wide variations of humidity, heat and cold.

TENNEY TEMPERATURE AND HUMIDITY CHAMBER

Designed for positive control of temperature, humidity and air circulation. Permits the accurate checking of physical quality, fragility, tension and other factors.

TENNEY SUB-ARCTIC INDUSTRIAL CABINETS

Designed for low-temperature testing of metals, radios, instruments, plastics, liquids, chemicals and pharmaceuticals. Temperature ranges of −40°F, −60°F, −95°F and −150°F are standard for each size.

For further information on these and other Tenney test equipment, write to Tenney Engineering, Inc.
Dept. K 26 Avenue B, Newark 5, New Jersey.

Tenney

Engineers and Manufacturers of Automatic Temperature, Humidity and Pressure Control Equipment

**CELLS, Photoelectric**
Bradley Labs.
Continental Elec. Co.
Dearborn Scientific
De Jur-Amsco Corp.
Eby, Inc.
Electronic Prod. Co.
**Federal Telephone**
Fredericks, George
General Elec. Co.
General Scientific Corp.
**Hickok Elec. Inst. Co.**
Instruments Dev. Labs.
International Rectifier
Leitz, Inc.
Luminite Elec. Co.
Photovolt Corp.
Phoenix Prec. Inst.
Porter, George K.
Potter Instrument
Precise Measurements
Rauland Corp.
RCA
Vacutron, Inc.
Vickers Electric
Westinghouse Electric Co.
Weston Elec. Inst. Corp.
Worner Electronics

**CELLS, Standard**
Cambridge Inst. Co.
Central Scientific
Eppley Lab.
Gray Instrument
Leeds & Northrup Co.
Phoenix Prec. Inst.
Rubicon Co.
Tagliabue Div.
Thwing-Albert
Weston Elec. Inst. Corp.

**CEMENT APPARATUS (See Testers & Testing Machines, Cement)**

**CEMENTING GAGES (See Gages, Cementing)**

**CEMENT MOLDS**
American Inst. Co.
Bowen & Co.
Central Scientific Co.
Fisher Scientific Co.
Humboldt Mfg. Co.
Olsen Testing Machine
Precision Scientific Co.
Standard Concrete App.

**CEMENT NEEDLE APPARATUS**
American Inst. Co.
Central Scientific
Fisher Scientific Co.
General Cement Mfg.
Humboldt Mfg. Co.
Olsen Testing Machine
Precision Scientific

**CENTRIFUGES**
Central Scientific
Clay Adams Co.
Fisher Scientific Co.
Glass Engg. Labs.
Goetze Niemer Co.
Haines Designed Prod.
International Equipment
Microchemical Service
Phipps & Bird
Podbielniak, Inc.
Precision Scientific Co.
Sargent & Co.
Specialized Insts.
Thomas Co., Arthur H.
Technical Products Co.
Williams Apparatus Co.

**CENTRIFUGES, Paper Testing**
International Equipment
Williams Apparatus Co.

**CENTRIFUGES, Oil Testing**
Boekel & Co.
Braun Corp.
Central Scientific Co.
Eclipse-Pioneer Div.
International Equip.
Moeller Inst. Co.
Podbielniak, Inc.
Precision Scientific Co.
Refinery Supply
Tagliabue Div.
Thomas Co., Arthur H.
Westinghouse Elec. & Mfg.

**CENTRIFUGES, Ultra-Speed**
Fisher Scientific Co.
Haines Designed Prod.
Precision Scientific

**CHAINS, SURVEYOR'S (See Surveying Instruments)**

**CHAMBERS, TEST & CALIBRATION**
American Instrument Co.
Anetsberger Bros.
**Atlas Electric Devices**
Bowser, Inc.
**Distillation Products**
**Electric Hotpack Co.**
Food Technology, Inc.
Gadgets, Inc.
**Ideal Lab. Tool**
Meriam Inst. Co.
**National Research**
**Premier Crystal Labs.**
Refrigeration Sys.
Revco, Inc.
Standard Cabinet Co.
Standard Products Inc.
Sub-Zero Prod. Div.
Tenney Engineering
**Thwing-Albert Inst. Co.**
**York Ice Machinery Corp.**

**CHART-GAGES for Optical Comparators**
Engineers' Specialties Div.

**CHECKERS, RADIO TUBE (See Analyzers, Radio Set)**

**CHEMICAL FEEDERS, Automatic pH Control**
Askania Regulator Co.
Bristol Co.
Electronic Prod. Co.
International Filter Co.
Lapp Insulator
Leeds & Northrup Co.
Milton Roy Co.
National Tech. Labs.
Neptune Pump
Omega Machine
**Permutit Co.**
Proportioneers, Inc.
Tagliabue Div.
**Wallace & Tiernan**

**CHEMICAL FEEDERS, Dry & Liquid**
Askania Regulator Co.
Builders-Providence
Fischer & Porter
Gump Co., B. F.
Jeffrey Mfg. Co.
Arthur D. Little
Milton Roy Co.
Neptune Pump
Omega Machine Co.
**Permutit Co.**
Phipps & Bird
Proportioneers, Inc.
Richardson Scale Co.
**Wallace & Tiernan Prod.**

**CHEMICAL PORCELAIN (See Porcelain, Laboratory)**

**CHLORINE CONTROL APPARATUS (See Controllers, Automatic, Chlorine)**

**CHLORINE TESTING APPARATUS (See Testers, Chlorine)**

**CHOKES**
Airdesign, Inc.
Amplifier Co.
Annis Co.
Audio Development
Better Coils Inc.
Bud Radio, Inc.
Chicago Transformer
Clough-Brengle Co.
Control Corp.
Fast & Co., John E.
Freed Transformer
Halldarson Co.
Harvey Radio Labs.
Instrument Resistors
Madison Elec. Prod. Div.
Mallory & Co.
Merit Transformer
National Co.
Ohmite Mfg. Co.
Radex Corp.
Raytheon Mfg. Co.
Sickles Co.
Sorensen & Co.
Standard Transformer
Superior Electric Co.
Sylvania Elec. Prod.
Thermador Elec. Mfg.
Thordarson Elec. Co.
Trenton Transformer
United Transformer Corp.

**CHOPPERS, D.C.—A.C.**
Applied Science Corp.
Liston-Folb
Millivac Instrument
Stevens-Arnold

**CHRONOGRAPHS**
American Inst. Co.
American Time Prods.
Aristo Import Co.
Cambridge Inst. Co.
Clebar Watch Co.
Ducommun Co.
Electro-Medical Lab.
Esterline-Angus Co.
Fecker, Inc.
Ferner Co.
Gaertner Scientific Corp.
General Elec. Co.
Gorrell & Gorrell
Hamilton Watch Co.
Hathaway Inst. Co.
Huggins Lab.
Jaeger Watch Co.
Jardur Import Co.
Leeds & Northrup
Metron Instrument
Nelson & Street
Pierce Watch Co.
Potter Instrument
Precision Thermometer
Sticht Co.

**CHRONOMETERS**
Bliss & Co.
Ducommum Co.
Elgin National Watch
Gaertner Scientific
Hamilton Watch
Jardur Import Co.
Negus, T. S. & J. D.
Potter Instrument
Standard Electric Time
Stoelting Co., C. H.
Waltham Watch Co.

**CHRONOSCOPE**
Amer. Chronascope
**Berkeley Scientific**
Potter Instrument
**Process & Instruments**
Rawson Elec. Inst.
**Stoelting Co., C. H.**

**CIRCUIT BREAKER ANALYZERS**
**Cincinnati Clock**
**Cole Instruments**
Esterline-Angus

**CIRCUITS, Printed Electric**
Allied Engraving & Stamp.
Cole Instrument
Engr. Research & Dev.
Gulton Mfg. Co.
Gurley, W & L. E.

**CLASSIFIERS, Particle Size, Air**
Federal Classifier
Fisher Scientific
Robinette Co.

**CLEANING MACHINES, Instrument (See Instrument Cleaning Machines)**

**CLINOGRAPHS, Bore Hole**
Geophysical Inst. Co.
Sperry-Sun Well Survey'g

**CLINOMETERS (for determining ceiling height of clouds)**
Alden Products
Alfax Paper & Eng.
Geier & Bluhm, Inc.
Leeds & Northrup
Stoelting Co., C. H.
White Co., Inc., David

**CLINOMETERS, Angular Measuring**
Engis Equipment
Ferner Co.
Jarrel-Ash Co.
Negus, T. S. & J. D.
Precision Thermometer
Warren-Knight Co.

**CLINOMETERS, Geologists**
Stratex Instrument Co.

**CLINOMETERS, Ship**
Eastern Specialty Co.
Hand & Sons
Instruments Corp.
Manning, Maxwell, Moore
Marine Compass
Moeller Inst. Co.
Negus, T. S. & J. D.
Northwest Instrument
Precision Thermometer
Serdex, Inc.

**CLOCKS, Master**
Alina Corp.
Cincinnati Time Rec. Co.
Elgin National Watch
Gaertner Scientific Corp.
General Electric Co.
International Bus. Mach.
Jacobs Instruments
Landis & Gyr, Inc.
National Time & Signal
Neomatic
Simplex Time Rec.
Standard Elec. Time
Stromberg Time Corp.
Telechron, Inc.
Thomas Clock Co.
Wallace & Tiernan
Waltham Watch

**CLOCKS, Minute Impulse & Synchronous**
Alina Corp.
**Betts & Betts**
Chelsea Clock Co.
Cincinnati Clock
Cincinnati Time Rec. Co.
Cramer & Co., Inc.
Elec. Tachometer Corp.
**Electyme Motor Products**
General Elec. Co.
Hansen Co.
Haydon Co.
International Bus. Mach.
Landis & Gyr.
Lumenite Electronic
National Time & Signal
Neomatic
Phipps & Bird
Simplex Time Rec.
Standard Elec. Time Co.
Stoelting Co.
Stromberg Time Corp.
Telechron, Inc.
Thomas Clock Co.
Tork Clock
Waltham Watch
Westinghouse Elec.

**CLOCKS, Primary**
Alina Corp.
Chelsea Clock Co.
Cincinnati Time Rec. Co.
Eclipse-Pioneer Div.
Elgin National Watch
General Elec. Co.
General Radio Co.
International Bus. Mach.
Landis & Gyr.
National Time & Signal
Roth Bros. Chronometer
Standard Elec. Time
Stromberg Time Corp.
Telechron, Inc.
Thomas Clock Co.
Wallace & Tiernan
Waltham Watch

**CLOCKS, Secondary**
Alina Corp.
Automatic Elec. Chicago
Cincinnati Time Rec. Co.
Elgin National Watch
General Elec. Co.
Howard Clock Products
International Bus. Mach.
Landis & Gyr
**National Time & Signal**
Simplex Time Rec.
Standard Elec. Time
Stromberg Time Corp.
Telechron, Inc.
Thomas Clock Co.
Waltham Watch

**CLOCKS, Standard**
Alina Corp.
Aristo Import Co.
Chelsea Clock Co.
Cincinnati Clock & Inst.
Cincinnati Time Rec.
Foxboro Co.
Gaertner Scientific Corp.
Hansen Co.
Jaeger Watch Co.
Kollsman Inst. Co.
Lux Clock Mfg. Co.

(Continued)

National Time & Signal
Negus, T.S. & J.D.
Seth Thomas Clock
Standard Elec. Time
Stromberg Time Corp.
Telechron, Inc.
Tork Clock Co.
Waltham Watch

**CLOCKS, Stop**
Boeckeler Instruments
Central Scientific Co.
Clebar Watch Co.
Dimo-Gray Co.
Elgin Nat. Watch
Fish-Schurman Co.
Glogau & Co.
Jaeger Watch Co.
Jardur Import Co.
National Time & Signal
Negus, T.S. & J.D.
Precision Scientific Co.
Standard Elec. Time
Sticht Co.
Stoelting Co., C. H.
Tagliabue Div.
Thompson Clock Co.
Telechron, Inc.
Waltham Watch

**CLOUD & POUR TEST APPARATUS**
Ace Glass Inc.
American Inst. Co.
Bowser Refrig. Inc.
Central Scientific Co.
Corning Glass Works
Fisher Scientific Co.
Humboldt Mfg. Co.
Koehler Inst. Co.
Kontes Glass Co.
Moeller Inst. Co.
Precision Scientific Co.
Refinery Supply Co.
Refrigeration Sys.
Ruehfel Co.
Scientific Inst. Co.
Scientific Glass App.
Tagliabue Div.
Tenney Engineering

**COAL METERS**
Bailey Meter Co.

**COIL TESTING EQUIPMENTS (See Testers, Coil)**

**COLLIMATORS, Vertical**
Berger & Sons
Dusenbery Co.
Engis Equipment
Fecker, J. W.
Gaertner Scientific
Geophysical Inst. Co.
Jacobs Instruments
Link Aviation Devices
Perkin-Elmer Corp.
Palos Optical Co.
Unertl Optical Co.
White Co. Inc.

**COLOR ANALYZERS, Photoelectric**
**Ansco**
**Applied Physics Corp.**
Bausch & Lomb Optical
Berkshire Laboratories
Central Scientific Co.
Dearborn Scientific
De-Tec-Tronic Labs.
**Ess Inst. Co.**
Farrand Optical
**Fish-Schurman Corp.**
Fisher Scientific Co.
Gaertner Scientific Corp.
Gardner Laboratory
General Electric Co.
General Radio Co.
Huggins Labs.
**Instrument Development**
Jacobs Instrument
Jarrell-Ash Co.
**Klett Mfg. Co.**
Librascope
Madison Elec. Prod.
National Tech. Labs.
Pfaltz & Bauer, Inc.
Photoswitch, Inc.
Photovolt Corp.
**Precise Measurements**
Rawson Elec. Inst. Co.
Rubicon Co.
Westinghouse Elec.
**Willmotte, Inc.**

**COLOR COMPARATORS, Photoelectric (See Color Analyzers, Photoelectric**

**COLOR COMPARATORS, Visual**
**Baird Associates**
**Bausch & Lomb Optical**
Central Scientific Co.
**Electronic Engineers**
**Fisher Scientific Co.**
**Gaertner Scientific Corp.**
**Gardner Laboratory**
**Hellige, Inc.**
**Instrument Dev. Labs.**
Jarrell-Ash Co.
**Klett Mfg. Co.**
**Koehler Instrument**
**LaMotte Chemical Prod.**
**Macbeth Corp.**
Menlo Research Lab.
Munsell Color Co.
Precise Measurements
Phipps & Bird
**Phoenix Precision Inst.**
Precise Measurements Co.
**Rascher & Betzold**
Tagliabue Div.
**Taylor & Co., W. A.**
Westinghouse Elec.
**Zeiss, Inc., Carl**

**COLOR GRADERS (See Color Analyzers, Photoelectric)**

**COLOR MATCHING OUTFITS (See Color Comparators, Visual)**

**COLORIMETER TUBES (See Colorimeters, Visual)**

**COLORIMETERS, Photoelectric**
American Inst. Co.
Associated Research
Berkshire Laboratories
Central Scientific Co.
Clay-Adams Co.
Coleman Instruments
Dearborn Scientific
De-Tec-Tronic Labs.
Farrand Optical
Fish-Schurman Corp.
Fisher Scientific
Gardner Laboratory
General Elec. Co.
Hellige, Inc.
Huggins Labs.
Instrument Dev. Labs.
Jarrell-Ash Co.
Klett Mfg. Co.
Leitz, Inc.
National Tech Labs.
Phoenix Prec. Inst.
Photovolt Corp.
Photron Instrument
Process Instruments
Rubicon Co.
Scientific Glass App.
Technical Products
Will Corporation

**COLORIMETERS, Visual**
American Inst. Co.
American Optical
Bausch & Lomb Optical
Central Scientific Co.
Coleman Electric Co.
Fischer & Porter
Fish-Schurman Corp.
Fisher Scientific Co.
Gardner Laboratory
Hellige, Inc.
Jarrell-Ash Co.
Klett Mfg. Co.
Koehler Instrument
Munsell Color Co.
Precise Measurements
Precision Scientific
Rascher & Betzold
Tagliabue Div.
Technical Products
Zeiss, Inc., Carl

**COMBUSTION, Indicators and Recorders (See Gas Analyzers, Boiler Meters, etc.)**

**COMBUSTION CONTROL EQUIPMENT (See Controllers, Automatic-Combustion)**

**COMBUSTION FURNACE, Laboratory, High Temperatures, see Furnace, Laboratory**

**COMMUNICATION MEASURING INSTRUMENTS**
American Automatic Elec.
Amplifier Co.
Ballantine Labs.
Boonton Radio Corp.
Brush Development Co.
Burlington Inst. Co.
Clarke Inst. Corp.
Clough Brengle Co.
Cole Instruments
Communication Meas. Lab.
Dale Instruments
Daven Co.
Elec. Indicator Co.
Electric Des. & Mfg.
Electronic Associates
Electronic Dev. Lab.
Esterline-Angus
Federal Telephone
Feiler Engineering
Ferris Inst. Corp.
Freed Transformer
General Electric Co.
General Radio Co.
Harvey Radio Labs.
Hewlett-Packard
Hickok Elec. Inst. Co.
Industrial Inst. Co.
Kay Electric Co.
Kellogg Switchboard
Leeds & Northrup Co.
Measurements Corp.
Millen Mfg. Co.
Precision Apparatus Co.
Premier Crystal Labs.
RCA Div.
Rubicon Co.
Sensitive Research Inst.
Shallcross Mfg. Co.
Sherron Metalic
Sound Apparatus
Sperry Gyroscope Co.
Stafford Co.
Sylvania Elec. Prod.
Technology Instrument
Thordarson Elec. Mfg.
Trimount Inst. Co.
Triplett Elec. Inst.
Varor Recovery Systems
West Coast Electronics
Westinghouse Elec.
Weston Elec. Inst. Corp.

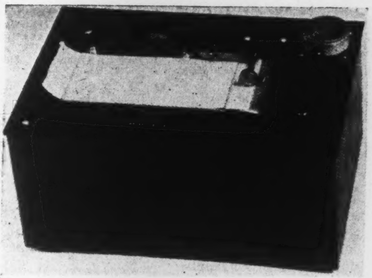
**COMPARATORS, A. C. Voltage**
Cole Instrument
DoALL Co.
Feiler Engineering

**COMPARATORS, Electrical Resistance**
Associated Research
Borden Engineering
Bowser, Inc.
Cole Instrument
Dice Co., J. W.
Electronic Instrument
Federal Products
Feiler Engineering
General Radio

**COMPARATORS, Mechanical**
American Meas. Insts.
Arma Corp.
Bryant Chucking
DoAll Co.
Electronic Research Labs.
Farrell-Birmingham (Gear Tooth)
Federal Prod. Corp.
Ferner Co.
Gaertner Scientific
Graham-Mintel Inst.
Hathaway Inst. Co.
Henson Co., Fred C.
Johnson Gage Co.
Leitz, Inc.
Maveg Mach. Sales
Metron Instrument
Mico Instrument Co.
Nankervis Co., G. L.
Park Sales
Pratt & Whitney
Precision Scientific
Scherr Co., Inc.
Sheffield Corp.
Size Control Co.
Standard Gage
Swedish Gage
Wilder, R. S.

**COMPARATORS, Optical**
American Meas. Inst.
Bausch & Lomb Optical
Brush Development
Cambridge Inst. Co.
Compar Instrument
DoAll Co.
Electronic Research Labs.
Engineers Specialty Div.
Fecker, Inc.
Ferner Co.
Fish-Schurman Corp.
Gaertner Scientific
Jarrell-Ash Co.
Jones & Lamson Mach.
Lab. Specialties
Leitz Inc.
Menlo Research Lab.
Precision Scientific
Ruska Inst. Corp.
Scherr Co., Inc.
Sheffield Corp.
Stocker & Yale
Van Keuren Co.
Zeiss, Inc., Carl

**COMPARATORS, Surface Finish Standards**
Compar Instrument
General Electric Co.
Link Engineering
Sheffield Corp.
Surface Checking Gage
Swedish Gage Co.



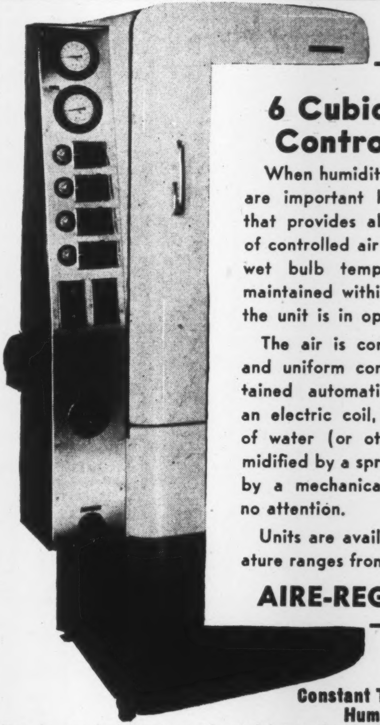
GARCEAU CHRONOGRAPHS

*Inkless Recording with Inertialess Marking System*

Models available with speed ranges from 1 mm per hour to 25 meters per second and with up to 100 traces. Supplied with plain or printed charts.

**Electro-Medical Laboratory, Inc.**
South Woodstock 7, Vermont

*Pioneer Makers of the Electroencephalograph*



**6 Cubic Feet of Controlled Air**

When humidity and temperature are important here is a cabinet that provides about 6 cubic feet of controlled air . . . both dry and wet bulb temperatures can be maintained within 1° F as long as the unit is in operation.

The air is constantly circulated and uniform conditions are maintained automatically; heated by an electric coil, cooled by a coil of water (or other coolant), humidified by a spray chamber, dried by a mechanical device needing no attention.

Units are available with temperature ranges from 40° F to 140° F.

**AIRE-REGULATOR**

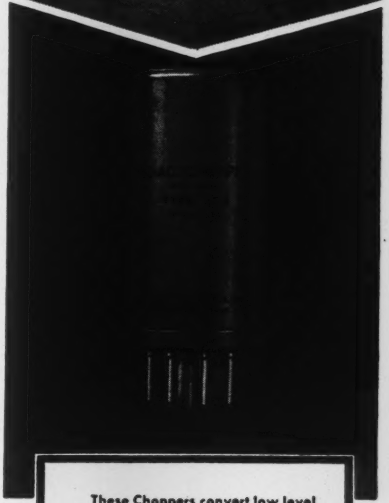
**Constant Temperature and Humidity Cabinets**

Now in use by many prominent laboratories in food, research, paint, pharmaceuticals, etc.—names on request. Write for bulletin and tell us your requirements.

**Food Technology Inc.**
5915 Northwest Highway
Chicago 31, Illinois

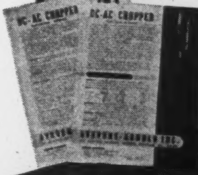
DC-AC
CHOPPER

A model for every use.
10 — 500 cycles AC
Meets AN Specifications
also 60 cycles
Single pole and double pole
Make-before-break contacts
Contacts in air or in liquid



These Choppers convert low level DC into pulsating DC or AC so that servo-mechanism error voltages and the output of thermocouples and strain gauges, may be amplified by means of an AC rather than a DC amplifier.

They are hermetically sealed, precision vibrators having special features which contribute to long life and low noise level.



WRITE FOR THESE CATALOGS . . .
#280
10-500 cycles
#246A
60 cycles

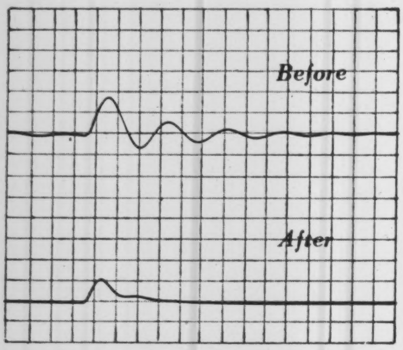
STEVENS
ARNOLD
INCORPORATED

[illegible] ELKINS STREET
SOUTH BOSTON 27, [illegible]

Engrg.

and Research Programs may be greatly *abbreviated* by a Philbrick Analog Computor of the high-speed all-electronic variety.

Dollars and days in surprising numbers have been saved by enterprising engrs. who have recognised the applicability of these little machines to their development probs.



How do we stabilize this structure or system? What is the optimum combination of these parameters? Why cannot this process be accelerated without sacrifice in efficiency? —

Questions of this sort and many others are answered regularly by analog systems assembled directly and conveniently from GAP/R Computor Components.

High-speed operation and all-electronic construction mean fast oscilloscopic solutions; they mean economy and versatility; and they mean the ability to explore quantitatively the inter-relation of conditions in a complex problem, and to come out with practical answers which might never have been obtained by any other means.

*Write for latest catalog*

G.A. Philbrick Rsrchs.
INCORPORATED
230 Congress Street Boston 10, Mass

**COMPASSES, Aircraft**
Aeromarine Inst. Co.
Autoflight Inst. Div.
Eclipse-Pioneer Div.
Electro-Mec Lab.
Elgin Natl. Watch Co.
Flight Research Eng.
General Elec. Co.
Giannini & Co.
Hagedorn Engineering
Hull Mfg. Co.
Koehler Instrument
Kollsman Inst. Co.
Marine Compass
Moisture Register Co.
RCA
Sperry Gyroscope Co.
Star Compass Co.
Summers Gyroscope
Suverkrop Instruments
Waltham Watch

**COMPASSES, Automobile**
Hull Mfg. Co.
Star Compass Co.
U. S. Gauge Co.

**COMPASSES, Azimuth**
Abrams Instrument
Ainsworth & Sons
Dusenbery Co.
Hopp Press
Keuffel & Esser Co.
Leupold & Stevens
Negus, T. S. & J. D.
Pioneer Instrument
Ritchie & Son
Summers Gyroscope
Suverkrop Instruments
Warren-Knight Co.

**COMPASSES, Dip**
Dusenbery Co.
Gurley, W. & L. E.
Keuffel & Esser Co.
Marine Compass Co.
Post Co.
Sprengnether Inst.
Taylor Inst. Cos.
Warren-Knight Co.

**COMPASSES, Drafting Room (See Drawing Instruments**

**COMPASSES, Gyro**
Arma Corporation
Eclipse-Pioneer Div.
Flight Research Eng.
General Elec. Co.
Sperry Gyroscope Co.
Summers Gyroscope

**COMPASSES Luminous prismatic**
Kollsman Instrument
Ritchie & Son
Suverkop Instruments
Taylor Inst. Cos.
White Co., Inc., David

**COMPASSES, Magnetic**
Aeromarine Inst. Co.
Ainsworth & Sons
Baker Compass Co.
Brunson Instrument
Dirigo Compass & Inst.
Dusenbery Co.
Eclipse-Pioneer Div.
Electro-Mec Lab.
Flight Research Co.
General Elec. Co.
Geophysical Inst. Co.
Gurley W. & L. E.
Hand & Sons
Hull Mfg. Co.
Keuffel & Esser Co.
Kollsman Inst. Co.
Leupold & Stevens
Marine Compass Co.
Marshall Co.
Negus T. S. & J. D.
Northwest Instrument
Post Co.
Ritchie & Son
Ruska Instrument
Star Compass Co.
Summers Gyroscope
Suverkop Instruments
Taylor Inst. Cos.
Testrite Instrument Co.
U. S. Gauge Co.
Waltham Watch
Warren-Knight Co.

**COMPASSES, Marine**
Arma Corporation
Baker Compass Co.
Bendix Marine Products
Bliss & Co.
Bunnell Co., J. H.
Dirigo Compass
Dusenbery Co.
Geophysical Inst. Co.
Hand & Sons
Hull Mfg. Co.
Kuner Co., Max
Marine-Compass Co.
Negus T. S. & J. D.
Northwest Instrument
Ritchie & Son
Sperry Gyroscope Co.
Starr Compass Co.

**COMPASSES, Radio**
Eclipse-Pioneer Div.
Fairchild Camera
Fisher Research Lab.
Hickok Elec. Inst. Co.
Lear, Inc.
Northwest Instrument
RCA Div.
Triumph Mfg. Co.

**COMPASSES, Ship (See Compasses, Marine**

**COMPASSES, Telltale (See Compasses, Marine)**

**COMPENSATION, Magnetic**
Dusenbery Co.
Geophysical Inst. Co.
Hand & Sons
Marine Compass

**COMPOUNDS, Cleaning & Rinsing for Instruments (See Instrument Cleaning Machines**

**COMPRESSORS, Instrument Air**
Ingersoll-Rand
Nash Engineering
Powers Regulator Co.

**COMPUTERS, Analog, Digital**
AiResearch Div.
Askania Regulator
Audio Instrument
Cole Instrument
Electro-Mec. Lab.
Engineering Res. Assoc.
Genisco Inc.
Jacobs Instrument Co.
Laboratory for Electronics
Librascope
Potter Instrument
Radioactive Products
Reed Research
Servo Corp.
Servo Tek Products
Specialties Inc.
Vectron, Inc.
Walkirt Co.

**COMPUTER, Simultaneous Equations**
Arma Corp.
Consolidated Engineering
Doelcam Instrument
Ford Inst. Co.
General Electric Co.
Hellver Instrument
Krohn-Hite Inst.
Laboratory for Electronics
Librascope
Philbrick Researches
Reeves Instrument

**COMPUTERS**
Abrams Instrument
Aero Electronics
American Paulin
Angle Computer Co.
Arma Corp.
Berkeley Scientific
Consolidated Engineering
Cook Electric
Doelcam Corp.
Engineering Res. Àss.
Ford Inst. Co.
General Electric
Hillyer Instrument
Hopp Press
Jacobs Instruments
Jardur Import
Krohn-Hite Inst.
Laboratory for Electronics
Librascope
Martin-Hubbard Corp.
Philbrick Researches
Potter Instruments
Radioactive Products
Reed Research
Reeves Instrument
Servomechanisms
Vectron, Inc.
Walkirt Co.

**CONCENTRATION RECORDERS**
Esterline-Angus Co.
Foxboro Co.
Industrial Insts. Inc.
Leeds & Northrup
Patwin Inst. Div.
Rubicon Co.
Skaneateles Mfg.

**CONDENSER, Electric (See Capacitors)**

**CONDENSER LEAKAGE, Indicators**
Associated Research
Clough-Brengle Co.
Electronic Design Corp.
Electronic Dev. Lab.
Feiler Engineering
Fox Valley Inst.
General Elec. Co.
Hickok Elec. Inst. Co.
Industral Inst. Inc.
Jackson Electrical Inst.
Leeds & Northrup Co.
Potter Co.
Radio City Products Co.
Rawson Elec. Inst. Co.
Reiner Electronics
Tobe Deutschmann Corp.
Triplett Elec. Inst.
Triumph Mfg. Co.
Weston Elec. Inst. Co.

**CONDENSER LEAKAGE, Recorders**
Esterline-Angus Co.
Leeds & Northrup

**CONDENSER TESTERS (See Testers, Condenser)**

**CONDUCTIVITY METERS**
American Inst. Co.
Bailey Meter Co.
Biddle Co., James G.
Brown Inst. Div.
Central Scientific Co.
Coleman Instrument
Electronic Prod. Co.
Esterline-Angus Co.
Foxboro Co.
Gray Instrument
Industrial Inst. Inc.
Instrument Lab., Inc.
Leeds & Northrup Co.
Minnesota Electronics
RCA
Revere Corp.
Rubicon Co.
Senstitive Research Inst.
Shallcross Mfg. Co.
Sherron Metallic
Thwing-Albert Instrument

**CONES, Pyrometric**
Accurate Pyrometric Cone
Fish-Schurman Co.
Gordon Co.
Henderson & Co.
Orton Ceramic Found.
Wheelco Insts. Co.

**CONES, Slump**
American Inst. Co.
Central Scientific Co.
Humboldt Mfg. Co.
Precision Scientific Co.
Riehle Div.

**CONNECTORS, Plugs, Clips, Posts, Jacks**
Aero Electric Corp.
Aerolite Electronic
Aircraft Marine Products
American Communications
American Inst. Co.
Audio Development
Autocall Co.
Automatic Elec. Chicago
Berkshire Laboratories
Breeze Corp.
Bud Radio, Inc.
Burke Electric Co.
Burndy Engineering
Cannon Electric
Carter Radio Co.
Cinema Engr.
Clare & Co.
Dittmore & Friemuth
Eastern Specialty Co.
Eby. Inc.
Federal Telephone
General Elec. Co.
General Radio Co.
Harvey-Wall Electronics
Johnson Co., E. F.
Jones, Howard B., Div.
Kellogg Switchboard
Lewis Engineering
Mallory & Co.
Meter Devices Co.
Millen Mfg. Co.
Pyle National
RCA
Revere Corp.
Richards Co., Inc.
Shallcross Mfg. Co.
Standard Elec. Time
States Co.
Teleoptic Co.
Thermo-Electric Co.
Thwing-Albert Inst. Co.
Winchester Electronics

**CONSISTENCY REGULATORS, Pulp & Paper (See Controllers, Automatic, Consistency**

**CONSTANT SPEED and Frequency Sets**
American Time Prods.
Doelcam Corp.
Elec. Tachometer Corp.
Gaertner Scientific Corp.
General Elec. Co.
Gibbs & Co.
Hastings Inst. Co.
Leeds & Northrup
Rockwell Engr.
Sorensen & Co.
Times Facsimile Corp.
Westinghouse Elec.

**CONTOUR MEASURING PROJECTORS**
Abrams Instrument
American Meas. Insts.
Askania Regulator
Bausch & Lomb Optical
Ferner Co.
Fish-Schurman Corp.
Jarrell-Ash Co.
Leitz, Inc.
Martin Hubbard Corp.
Scherr Co., Inc.
Sheffield Corp.
Stocker & Yale
Wilder, R. S.

**CONTROL BOARDS and Housings**
Allied Engraving & Stamp.
Askania Regulator
Automatic Temp. Control
Barnes Co., W. F. & J.
Bristol Co.
Bud Radio, Inc.
Dorothea Mechanisms, Gale
Falstrom Co.
Kirk & Blum Mfg.
Panellit
Richardson Scale Co.
Standard Elec. Time

**CONTROL DRIVES (See Servo-Motors)**

**CONTROLS, AUTOMATIC (See Controllers, Automatic)**

**CONTROLLERS, AUTOMATIC (See object of Measurement and Control)**

**"CONTROL" —NOTE—**

**The following pages deserve close study. Note for example that after numerous "Controllers, Automatic" there are three classes of "Controllers, Manual." Look up also under "Regulators" for many types thus termed by usage. Also "Thermostats" and other commonly-used names of specific-purpose, automatic controllers.**

**As a rule, Automatic Controllers are "Instrument like" while devices known as Controls (preceded by name of application) are simple, single-purpose devices.**

**CONTROLLERS, AUTOMATIC, Ammonia (See Ammonia Control Equipment)**

**CONTROLLERS, AUTOMATIC, Beater (See Controllers, Automatic, Consistency**

**CONTROLLERS, AUTOMATIC, Bin (See Controllers, Automatic, Granular Material, Level)**

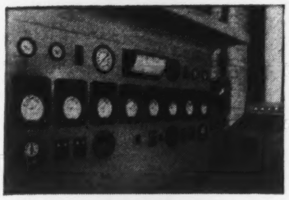
**CONTROLLERS, AUTOMATIC, Boiler Feed**
Ace Instrument
Askania Regulator Co.
Atlas Valve Co.
Bailey Meter Co.
Campbell Co., J. A.
Climax Div.
Combustion Control Corp.
Fisher & Porter
Fisher Governor
Foster Engg. Co.
Foxboro Co.
General Controls
Hammel-Dahl- Co.
Henszey Co.
Jo-Bell Products
Kieley & Mueller
Leeds & Northrup
Lumenite Electronics
Magnetrol, Inc.
Manning-Maxwell & Moore
Mason-Neilan Regulator
McAlear Mfg.
Mercoid Corp.
Mercon Regulator Co.
Minneapolis-Honeywell
Natural Gas Equipment
Northern Equip. Co.
Photoswitch, Inc.
Republic Flow Meters Co.
Ruggles Klingemann
Squires Co., C. E.
Swartwout Co.
Taylor Inst. Cos.
Trimount Inst. Co.
Warrick Co.
Watts Regulator Co.
Wheelco Instruments

**CONTROLLERS, AUTOMATIC, Boiler Water Concentration**
Campbell Co., J. A.
Fischer & Porter
Foxboro Co.
General Controls
Hammel-Dahl Co.
Henszey Co.
Jo-Bell Products
Leeds & Northrup Co.
Lumenite Electronics
Manning, Maxwell & Moore
Mason-Neilan Reg.
Minneapolis-Honeywell
Photoswitch, Inc.
Powers Regulator
Republic Flow Meters

**CONTROLLERS, AUTOMATIC, Bulk Material Level (See Controllers, Automatic, Granular Material Level)**

**CONTROLLERS, AUTOMATIC, Chlorine**
Arca Regulators, Inc.
Askania Regulator Co.
Beckman Instruments
Brooks Rotameter
Builders-Providence
Cash Co.
Fischer & Porter
Foster Engineering
Foxboro Co.
General Controls
Hammel-Dahl Co.
LaMotte Chemical Prod.
Lapp Insulator
Magnetrol, Inc.
Manning, Maxwell & Moore
National Meter Co.
Photoswitch, Inc.
Proportioneers, Inc.
Rasher & Betzold
Republic Flow Meters
Shallcross Controls
Taylor Inst. Co.
Wallace & Tiernan

**CONTROLLERS, AUTOMATIC, Combustion**
Ace Instrument Co .
Arca Regulators, Inc.
Askania Regulator Co.
Bailey Meter Co.
Beckman, Inc., Arnold O.
Bristol Co.
Brooke Eng. Co.
Burrell Technical
Cambridge Inst. Co.
Cash Co.
Cleveland Fuel Eng.
Combustion Control Corp.
Electronic Prod. Co.
Fischer & Porter
Fisher Governor
Foxboro Co.
Furst Electronics
General Controls
General Power Plant
General Regulator Corp.
Hagan Corp.
Hammel-Dahl Co.
Hays Corp.
Leeds & Northrup Co.
Mason-Neilan Reg. Co.
Mercoid Corp.
Mine Safety Appliances
Minneapolis-Honeywell
National Brass Co.
Natural Gas Equipment
North American Mfg.
Partlow Corp.
Perfex Corp.



# BAILEY METER *Combustion* CONTROL

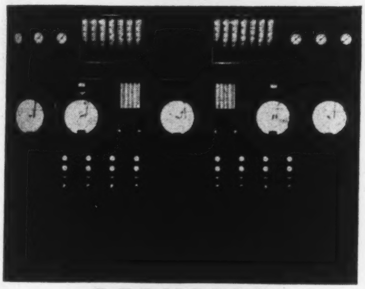
● Bailey Meter Automatic Combustion Control of boilers results in substantial saving in fuel; increased boiler capacity; reduction of boiler and furnace maintenance; more time for operators to devote to general station maintenance; and improvement in the general character of service.

Bailey Meter Control makes possible the everyday operation of boilers at test efficiencies because it is a complete combustion control system which (1) automatically maintains steam pressure by supplying fuel and air simultaneously to boilers in accordance with changes in steam demand, (2) automatically maintains most economical fuel-air ratio by incorporating the Bailey Boiler Meter as an integral part of the system, (3) automatically maintains the desired furnace draft, and (4) automatically distributes load among boilers so that each unit carries its share.

This sturdy inexpensive air-operated control system has been applied to all sizes and types of boilers ranging from 200 h.p. upward. It is applicable to all fuels and all methods of firing.

For further information consult Sweet's Engineering Catalogs or write for bulletin No. 102.

**BAILEY METER COMPANY**
1041 IVANHOE ROAD · CLEVELAND, O.
Bailey Meter Company Ltd. Montreal, Canada



## REPUBLIC COMBUSTION CONTROL

Republic automatic combustion control is available for all sizes of boilers, all types of fuel firing, all load conditions and any arrangement of draft equipment.

The Republic combustion control (1) automatically maintains constant steam pressure by controlling the heat input to the boilers; (2) automatically maintains highest combustion efficiency by controlling simultaneously the fuel and air input in measured proportions; (3) automatically maintains any desired load division between the boilers; (4) automatically maintains the correct constant draft in each furnace.

**WRITE FOR DATA BOOK No. S-21**

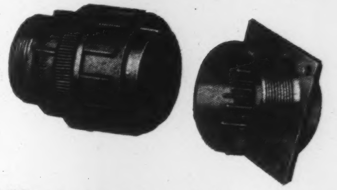
**REPUBLIC FLOW METERS CO.**
**2240 Diversey Pkwy. Chicago 47, Ill.**

**REPUBLIC**
**INSTRUMENTS • CONTROLS**

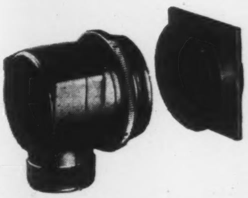
---

# CANNON PLUGS

*the highest quality and greatest variety for the instrument industry*

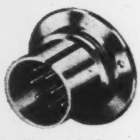


**AN** Originally dsigned for Army-Navy Specification requirements. Now used widely for instruments. Connects and disconnects by screw action of threaded coupling ring. Made in 2 plug types—3 receptacles with variations and accessories, in 15 shell sizes and more than 200 insert arrangements.

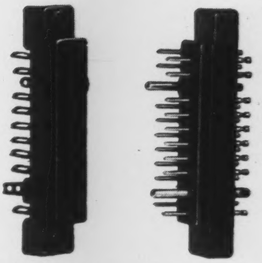


**K** Light weight, aircraft type connector ideal for many instruments. Connects and disconnects manually. Is held together by Acme thread coupling ring. Made in 7 shell types in 8 different diameters and more than 190 insert arrangements.

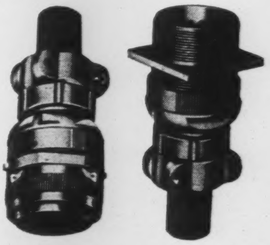
**GS** Hermetically sealed by use of glass beads fused to shell and contact, both machined from cold rolled steel. Made in 2 shell types—10 diameters and currently having 30 layout arrangements. Additional arrangements are being designed.



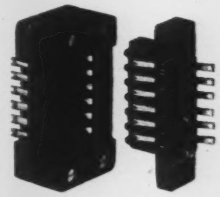
**RS** Hermetically sealed with special resilient rubber inserts. Specially adapted to aircraft relays and other sealed components. These fittings mate with standard "AN" Connectors having corresponding inserts.



**DPM** This series used primarily on electronic equipment where a multiple contact, rack and panel connector of extremely small dimensions is required. Both plug and receptacle are rigidly mounted. Connect and disconnect automatically when assemblies, to which they are mounted, are joined or separated. Made in 2 sizes having 2 contact arrangements.



**AN-M** For the tough jobs. Moisture-proof, vibration-proof and pressurized. Radio shielding is provided and all threaded parts are drilled for safety wiring. Connect and disconnect by screw action of threaded coupling ring. The variety of sizes and layout arrangements is nearly as great as the AN line.



**RTC** Is a quick disconnect requiring low separation force and having simple mounting requirements for chassis or wall types. Moisture drain holes provided in receptacle section. Plug section provides for lacing down wires after soldering. Made in five sizes.

**CANNON ELECTRIC**
**Since 1915**
CANNON ELECTRIC COMPANY
FACTORIES IN LOS ANGELES, NEW HAVEN, TORONTO
REPRESENTATIVES IN PRINCIPAL CITIES

For engineering data on any of these Cannon Plugs request free bulletins by type, such as "K", "GS", "RTC", etc. Address your request to Cannon Electric Company, P.O. Box 75, Lincoln Heights Station, Los Angeles 31, Calif.

**PROTECTOGLO Combustion Safeguard**

*For Flame Failure Protection*

The Protectoglo operates on the "flame rectification" principle . . . the safest and most fool-proof method of flame failure protection. Failure automatically results in complete safety shut-down. Four different flame detector units afford versatility of application.

Write for Catalog 9601. MINNEAPOLIS-HONEYWELL REGULATOR Co., *Industrial Division*, 4579 Wayne Ave., Phila. 44, Pa.

*Straight type flame electrode rectifier.*

MINNEAPOLIS
**Honeywell**
Brown Instruments

Photoswitch, Inc.
Republic Flow Meters
Sampsel Time Control
Shallcross Controls
Surface Combustion
Taylor Instrument Cos.
Worner Electronics

**CONTROLLERS, AUTOMATIC, Condensation**

Bailey Meter Co.
Boylston Co.
Cash Co.
Emmett Machine
Fisher Governor Co.
General Controls
General Regulator Corp.
Hammel-Dahl Co.
Jo-Bell Products
Manning, Maxwell & Moore
Photoswitch, Inc.
Powers Regulator
Schade Valve Mfg. Co.
Seely Inst. Co., Inc.
Tagliabue Div.
Taylor Inst. Cos.

**CONTROLLERS, AUTOMATIC, Condenser Leakage**

Foxboro Co.
Kellogg Switchboard
Leeds & Northrup Co.
Manning, Maxwell & Moore
Warrick Co.

**CONTROLLERS, AUTOMATIC, Consistency**

Askania Regulator Co.
Brabender Corp.
Bristol Co.
Electric Eye Equipment
Foxboro Co.
General Controls
Hammel-Dahl Co.
Mason-Neilan Regulator
McAlear Mfg.
Merritt Engr. & Sales
Northern Equip. Co.
Robinette Co.
Shallcross Controls
Taylor Inst. Cos.

**CONTROLLERS, AUTOMATIC, Counting**

Abrams Instrument
Adde & Co.
Automatic Elec. Sales
Automatic Temp. Control
Bristol Co.
Counter & Control Corp.
De-Tec-Tronic Labs.
Eagle Signal Corp.
Electronic Controls
Engineering Res. & Dev.
General Electric
Lansing Engineering

(Continued)

Lumenite Electric Co.
Manning, Maxwell & Moore
Martin-Hubbard Corp.
National Time & Signal
Nuclear Inst. & Chem.
Photoswitch, Inc.
Potter Instrument
RCA
Rockwell Engr.
Servo Corp. of Amer.
Standard Electric Time
Taller & Cooper

**CONTROLLERS, AUTOMATIC, Current (See Regulators)**

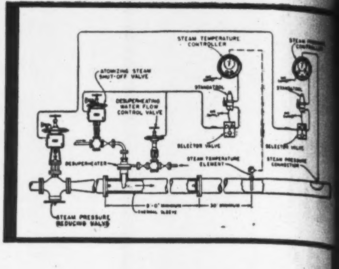
**CONTROLLERS, AUTOMATIC, Cycle**

Abrams Instrument
Adde & Co.
Autocall Co.
Automatic Temp. Control
Bailey Meter Co.
Barber Colman
Barnes Co., W. F. & J.
Betts & Betts
Bristol Co.
Brooks Rotameter
Climax Div.
Counter & Control Corp.
Cramer Co., Inc.

(Continued)

Denver Fire Clay Co.
Dorothea Mechanisms, Gale
Electronic Controls
Emmett Machine
Fisher Governor
Fisher-Pierce Co.
Foxboro Co.
General Controls
General Elec. Co.
Gotham Instrument
Hagan Corp.
Haydon Co., A. W.
Industrial Timer Corp.
Industrol Corp.
Leeds & Northrup Co.
Lumenite Electronic
Manning, Maxwell & Moore
Martin-Hubbard Corp.
Mason-Neilan Reg. Co.
Minneapolis-Honeywell
Monitor Controller Co.
National Time & Signal
Paragon Electric Co.
Photoswitch
Potter Instrument
Powers Regulator
Robinette Co.
Seely Inst. Co., Inc.
Servo Corp. of Amer.
Sinclair-Collins
Skaneateles Mfg.

(Continued)

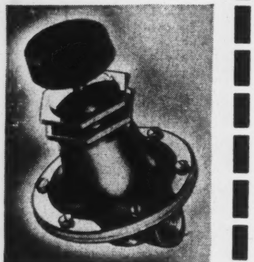

STEAM TEMPERATURE CONTROLLER
ATOMIZING STEAM SHUT-OFF VALVE
DESUPERHEATING WATER FLOW CONTROL VALVE
SELECTOR VALVE
DESUPERHEATER
STEAM TEMPERATURE ELEMENT
STEAM PRESSURE CONNECTION
THERMAL SLEEVE
STEAM PRESSURE REDUCING VALVE

**DESUPERHEATING & PRESSURE REDUCING CONTROL**

● Bailey Meter Control of desuperheating and pressure reducing incorporates standard Bailey Controllers for both pressure and temperature, as well as a special Bailey Reducing Valve equipped with valve positioner and air cooled packing gland.

The control system is air-operated and is arranged to maintain the desired final steam temperature by controlling the quantity of water fed to the desuperheater. This temperature is measured by a sensitive temperature controller with the temperature element located at the outlet of the ● desuperheater.

**BAILEY METER COMPANY**
1041 IVANHOE ROAD · CLEVELAND O
Bailey Meter Company Ltd. Montreal, Can



**PRECISION REGULATION**

**Within .005 psi**

**FOR MANUAL LOADING SERVICE**...for remote positioning . . . for accurate flow meter calibration, our MODEL H-10 is tops in the field.

It's built especially for dead end (no flow) service . . . and guaranteed to be free from "drift" errors. Ranges 0-5; 0-25; 0-50; 0-125 psi for inlet pressures to 150 psi.

If you are looking for a pneumatic regulator that is sensitive to 005 psi (in 0-5 psi range), stable and foolproof, **HERE'S YOUR REGULATOR.**

**WRITE TODAY FOR BULLETIN PH-10-I**

**CONOFLOW CORPORATION**
**2100 Arch St., Phila. 3, Pa.**

Cono Controls

instrumentality

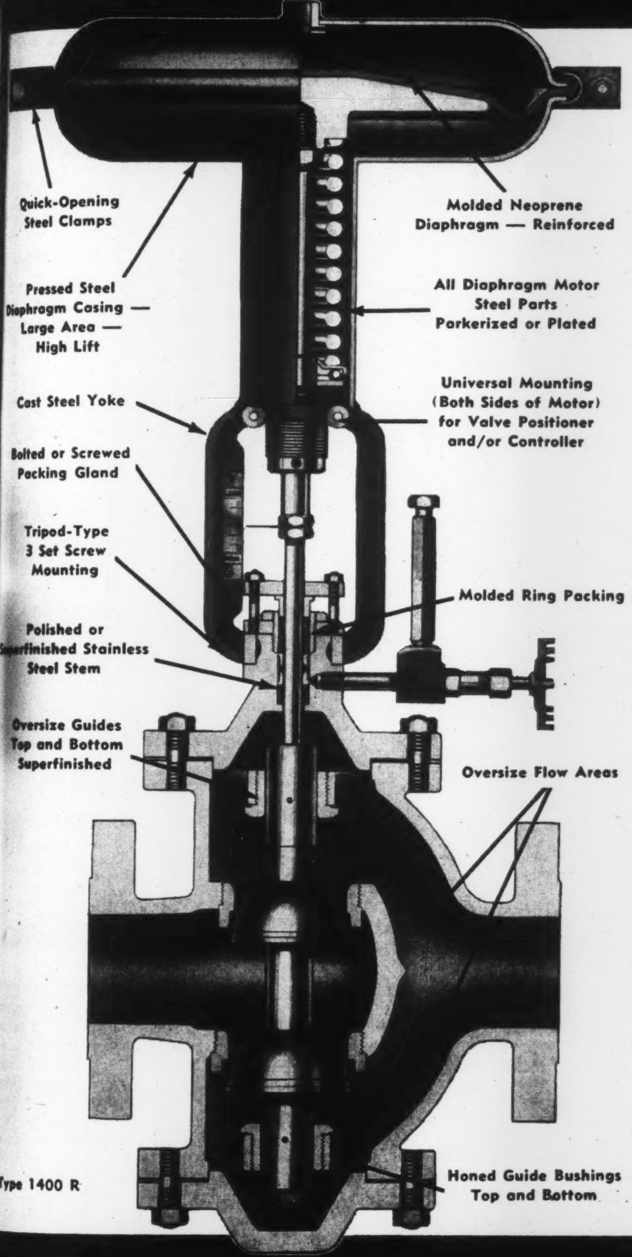
**COMBUSTION SAFEGUARD**

**for positive protection against explosion hazards!**

Specify the Wheelco FLAME-OTROL—a completely engineered combustion safeguard system in one compact package. Get safety and uninterrupted operation for oil and gas fired ovens, boilers, kilns, and other heating equipment. Ask for Bulletin F2-1, Wheelco Instruments Company, 843 West Harrison St., Chicago 7, Illinois.

**wheelco** *electronic controls*

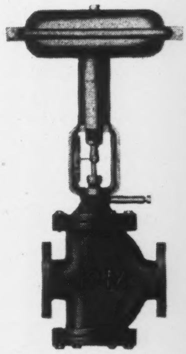
# K&M EQUIPMENT FOR MODERN PROCESS CONTROL

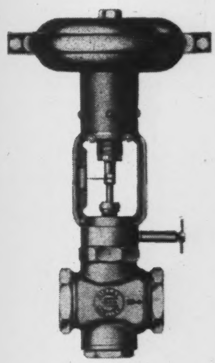

Quick-Opening Steel Clamps
Molded Neoprene Diaphragm — Reinforced
Pressed Steel Diaphragm Casing — Large Area — High Lift
All Diaphragm Motor Steel Parts Parkerized or Plated
Cast Steel Yoke
Universal Mounting (Both Sides of Motor) for Valve Positioner and/or Controller
Bolted or Screwed Packing Gland
Tripod-Type 3 Set Screw Mounting
Molded Ring Packing
Polished or Superfinished Stainless Steel Stem
Oversize Guides Top and Bottom Superfinished
Oversize Flow Areas
Honed Guide Bushings Top and Bottom

Type 1400 R

Outstanding performance records make K & M Advanced Type Control Valves first in the regard of many instrument engineers. Today most leading companies are using K & M equipment.

K & M has the facilities to help you solve new problems and to handle the smallest or largest control valve requirement. Look with confidence to K & M for counsel and assistance in planning new control installations and improving old ones.


Type 1200


Type 1000

## OTHER KIELEY & MUELLER PRODUCTS

Pressure Reducing & Regulating Valves
Liquid Level Controls
Strainers
Pump Governors
Back Pressure and Relief Valves
Float Valves
Exhaust Heads
Stop and Check Valves

**KIELEY & MUELLER, INC.**

NORTH BERGEN, N. J.
*Established 1879*

Taco West Corp.
Tagliabue Div.
Taylor Inst. Cos.
Tork Clock

**CONTROLLERS, AUTOMATIC, Damper**

Ace Instrument Co.
Arca Regulators, Inc.
Askania Regulator Co.
Atlas Valve Co.
Automatic Temp. Control
Bailey Meter Co.
Barber-Colman Co.
Beck Co.
**Belfield Div.**
Bristol Co.
Brooke Eng. Co.
Cash Co.
Cleveland Fuel Equip.
Cook Electric Co.
Davis Reg. Co.
Denver Fire Clay Co.
Electronic Prod. Co.
Fisher Governor
Foster Eng. Co.
Foxboro Corp.
Fuel Watchman
Fulton Sylphon Co.
General Controls
General Power Plant
General Regulator Corp.
Gleason-Avery, Inc.
Hagan Corp.
Hammel-Dahl Co.
Hays Corp.
Johnson Service Co.
Kieley & Mueller
Leeds & Northrup Co.
Mason-Neilan Regulator
Manning, Maxwell & Moore
Mercoid Corp.
Minneapolis-Honeywell
Natural Gas Equipment
Perfex Corp.
Powers Regulator Co.
Preferred Utilities Mfg.
Republic Flow Meters
Robinette Co., W. C.
Ruggles-Klingemann
Sampsel Time Control
Schade Valve Mfg. Co.
Shallcross Controls
Spence Eng. Co., Inc.
Summers Gyroscope
Tagliabue Div.
Taylor Instrument Cos.
White-Rodgers Electric

**CONTROLLERS, AUTOMATIC, Density**

Acme Regulator Co.
Arca Regulators, Inc.
Askania Regulator Co.
Automatic Valve Control
Bailey Meter Co.
Ess Instrument Co.
Foxboro Co.
General Controls
General Power Plant
Hagan Corp.
Hays Corp.
Lumenite Electric Co.
Manning, Maxwell & Moore
Mine & Smelter Supply
Minneapolis-Honeywell
Moore Products
Norcross Corp.
Precision Thermometer
Republic Flow Meters
Shallcross Controls
Tagliabue Div.
Taylor Instrument Cos.

**CONTROLLERS, AUTOMATIC, Desuperheat**

Arca Regulators, Inc.
Askania Regulator Co.
Atlas Valve Co.
Bailey Meter Co.
Bristol Co.
Brown Inst. Div.
Foxboro Corp.
General Regulator Corp.
Hagan Corp.
Hammel-Dahl Co.
Industrol Corp.
Leeds & Northrup Co.
Manning, Maxwell & Moore
Mason-Neilan Regulator
Mercon Regulator Co.
Northern Equip. Co.
Penn Ind. Inst.
Republic Flow Meters Co.
Spence Eng. Co., Inc.
Swartwout Co.
Tagliabue Div.
Taylor Inst. Cos.
Trerice Co.

**CONTROLLERS, AUTOMATIC, Draft**

Ace Instrument Co.
Arca Regulators, Inc.
Askania Regulator Co.
Atlas Valve Co.
Automatic Temp. Control
Bailey Meter Co.
Barber-Colman Co.
Beck Co.
Bristol Co.
Brooke Eng. Co.
Cash Co.
Cleveland Fuel Equip.
Denver Fire Clay Co.
Foster Eng. Co.
Foxboro Co.
General Controls
General Power Plant
General Regulator Corp.
Gleason-Avery, Inc.
Hagan Corp.
Hammel Dahl Co.
Hays Corp.
Leeds & Northrup Co.
Manning, Maxwell & Moore
Mason-Neilan Regulator
National Airoil Burner
Perfex Corp.
Preferred Utilities Mfg.
Republic Flow Meters
Robinette Co., W. C.
Ruggles-Klingemann
Sampsel Time Control
Schade Valve Mfg.
Seely Inst. Co., Inc.
Shallcross Controls
Tagliabue Div.
Taylor Inst. Cos.

**CONTROLLERS, AUTOMATIC, Feed Water**

Askania Regulator Co.
Atlas Valve Co.
Automatic Temp. Control
Bailey Meter Co.
B. W. Controller Corp.
Campbell Co., J. A.
Climax Div.
Combustion Control
Davis Regulator
Defender Automatic Reg.
Fisher & Porter
Fisher Governor
Ford Regulator Valve
Foxboro Co.
General Controls
General Regulator
Hagan Corp.
Hammel-Dahl Co.
Jo-Bell Products
Kieley & Mueller
Leslie Co.
Lumenite Electronic
Magnetrol, Inc.
Manning, Maxwell & Moore
Mason-Neilan Reg. Co.
McAlear Mfg.
Mercon Regulator Co.
Minneapolis-Honeywell
Natural Gas Equipment
Northern Equip. Co.
Photoswitch, Inc.
Republic Flow Meters
Revere Corp.
Ruggles-Klingemann
Schade Valve Mfg. Co.
Simplex Valve & Meter
Squires Co.
Swartwout Co.
Tagliabue Div.
Taylor Inst. Co.
Trimount Inst. Co.
Wheelco Instruments

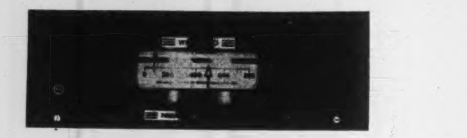
**CONTROLLERS, AUTOMATIC, Filter Rate**

Builders-Providence
Fischer & Porter
Foxboro Co.
Kates Co., W. A.
Manning, Maxwell & Moore
Mason-Neilan Reg. Co.

(Continued)

instrumentality

ELECTRONIC CONTROLLER

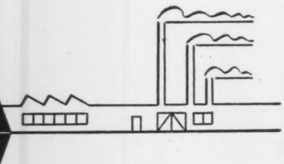


FOR MEASUREMENT, INDICATION AND CONTROL

Wheelco instru*mentality* in the Wheelco CAPACITROL gives you instantaneous automatic control action for temperature, current, static strain loads and other electrically measurable factors. When specifying instruments, specify Wheelco—get economy plus instru*mentality* in action. Ask for condensed catalog. Wheelco Instruments Company, 843 W. Harrison St., Chicago 7, Illinois.

wheelco *electronic controls*

COMPUTING CONTROLS for INDUSTRY



- CONTROLS
- SERVOS
- COMPONENTS

$$\mu_2(d) = \frac{1}{m}\sum n_j(a_j - a)^2$$

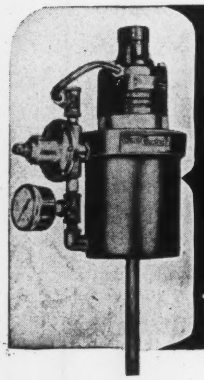
$$\frac{1}{2T}\int_{-T}^{T} f_1(t)\, f_1(t+\tau)\,dt$$

$$X_K = A_K\left(1 - \sum_{k=1}^{n} X_K\right)$$

$$Z = \int_{\lambda_1}^{\lambda_2} E_Z\, f(\lambda)\,d\lambda$$

Fifteen years of leadership in this important field is available to consider your requirements.

LIBRASCOPE
TRADE MARK
INCORPORATED
1607 FLOWER STREET, GLENDALE, 1, CALIFORNIA



Up to 5 times faster response with NEW CONOFLOW PNEUMATIC CYLINDER MOTORS for THROTTLING CONTROL

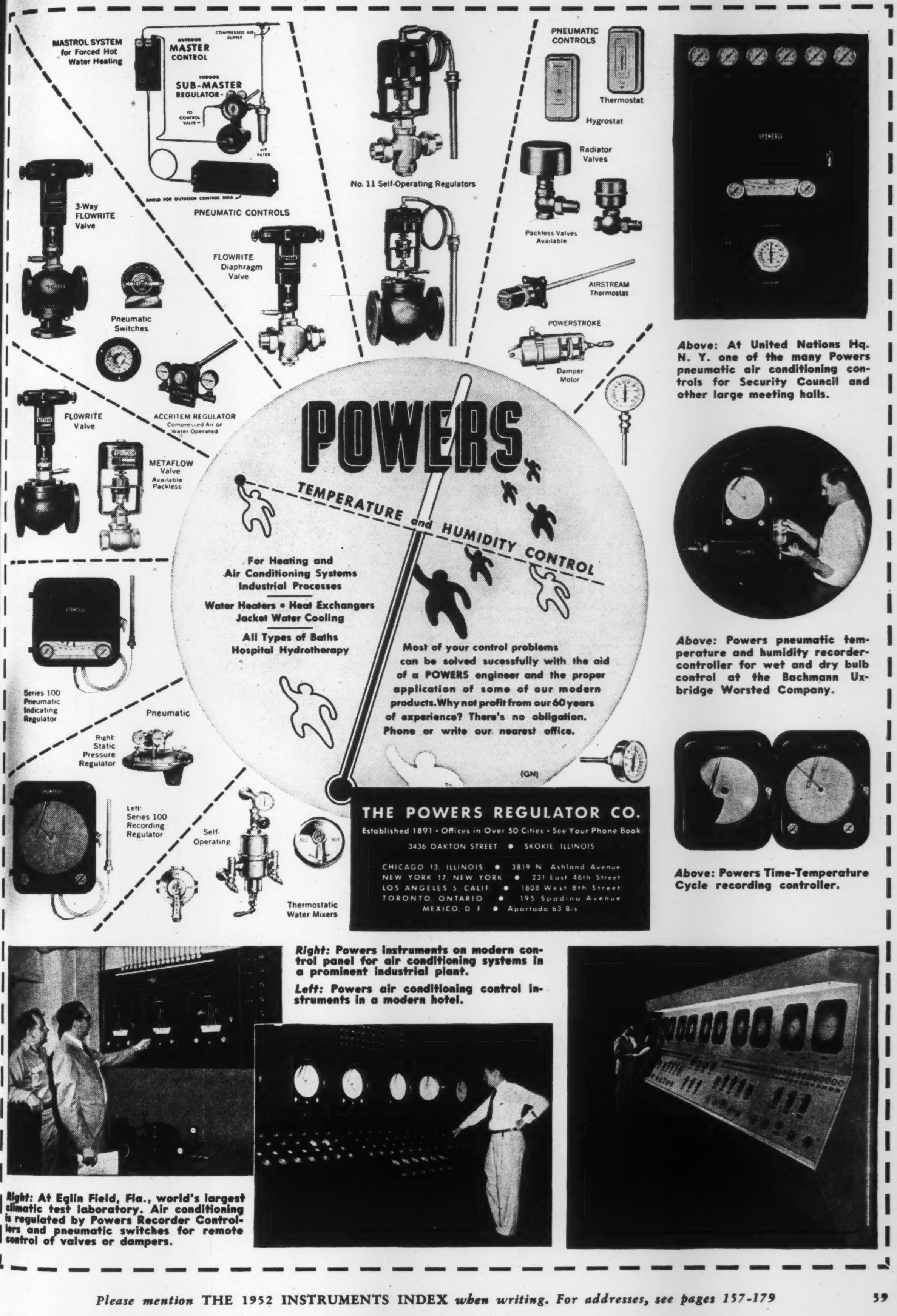
The New B-50 Series of pneumatic cylinders for throttling control service operate on air pressures up to 100 psig and are capable of repositioning accuracies of 1/500 part of total stem travel. Simplified one-piece piston construction features graphite impregnated "O" ring seals and a piston positioner integrally mounted in the head plate. Extra sensitive, speedy and stable—because of minimum friction and precisioned aluminum design.

Many applications include positioning electrical components, variable speed drives, rubber pinch valves, etc. Available in 4", 6" and 8" diameters with 3" and 4" stem travels. Furnished complete with cushion-loading regulator and gauge, fully piped, ready for installation.

Write for bulletin B-50-I.

CONOFLOW CORPORATION
2100 Arch St., Phila. 3, Pa.

Cono Controls


MASTROL SYSTEM for Forced Hot Water Heating
OUTDOOR MASTER CONTROL
COMPRESSED AIR SUPPLY
INDOOR SUB-MASTER REGULATOR
TO CONTROL VALVE
AIR FILTER
SHIELD FOR OUTDOOR CONTROL BULB
PNEUMATIC CONTROLS
No. 11 Self-Operating Regulators
PNEUMATIC CONTROLS
Thermostat
Hygrostat
Radiator Valves
Packless Valves Available
AIRSTREAM Thermostat
POWERSTROKE
Damper Motor
3-Way FLOWRITE Valve
FLOWRITE Diaphragm Valve
Pneumatic Switches
ACCRITEM REGULATOR Compressed Air or Water Operated
FLOWRITE Valve
METAFLOW Valve Available Packless
Series 100 Pneumatic Indicating Regulator
Pneumatic
Right: Static Pressure Regulator
Left: Series 100 Recording Regulator
Self-Operating
Thermostatic Water Mixers
POWERS
TEMPERATURE and HUMIDITY CONTROL
(GN)

For Heating and Air Conditioning Systems Industrial Processes

Water Heaters • Heat Exchangers Jacket Water Cooling

All Types of Baths Hospital Hydrotherapy

Most of your control problems can be solved sucessfully with the aid of a POWERS engineer and the proper application of some of our modern products. Why not profit from our 60 years of experience? There's no obligation. Phone or write our nearest office.

**THE POWERS REGULATOR CO.**

Established 1891 • Offices in Over 50 Cities • See Your Phone Book

3436 OAKTON STREET • SKOKIE, ILLINOIS

CHICAGO 13, ILLINOIS • 3819 N. Ashland Avenue
NEW YORK 17, NEW YORK • 231 East 46th Street
LOS ANGELES 5, CALIF. • 1808 West 8th Street
TORONTO, ONTARIO • 195 Spadina Avenue
MEXICO, D. F. • Apartado 63 Bis

***Above:*** **At United Nations Hq. N. Y. one of the many Powers pneumatic air conditioning controls for Security Council and other large meeting halls.**

***Above:*** **Powers pneumatic temperature and humidity recorder-controller for wet and dry bulb control at the Bachmann Uxbridge Worsted Company.**

***Above:*** **Powers Time-Temperature Cycle recording controller.**

***Right:*** **Powers instruments on modern control panel for air conditioning systems in a prominent industrial plant.**

***Left:*** **Powers air conditioning control instruments in a modern hotel.**

***Right:*** **At Eglin Field, Fla., world's largest climatic test laboratory. Air conditioning is regulated by Powers Recorder Controllers and pneumatic switches for remote control of valves or dampers.**

Bailey FEED WATER Control

● Bailey Meter Company offers three distinct feed water control systems. They are (1) the Thermo-hydraulic Feed Water Regulator which is suitable for the majority of small boilers operating at relatively low pressures. This regulator operates from water level alone and is provided with a fully balanced tight seating V-port regulating valve designed to give a straight line characteristic. It offers the advantages of low installation cost, removable valve parts and independence of valve location.

(2) The Single-Element air-operated feed water control system is recommended for installations on which smooth regulation of feed water flow is desired, and a wide regulating range cannot be used. This system is controlled by water level alone as measured by a Bailey Boiler Drum Water Level Recorder.

(3) Bailey Three-Element feed water control is recommended for high capacity low water storage boilers operating at high pressures or for boilers operating at medium pressures with violent load fluctuations. This system is based on actual measurement of water flow to the boiler, steam flow from the boiler and water level within the boiler, and is adjusted primarily to control the rate of water flow to the boiler so that it equals the rate of steam flow from the boiler.

For detailed information consult Sweet's Engineering Catalogs or request bulletin ● No. 105.

BAILEY METER COMPANY
1041 IVANHOE ROAD · CLEVELAND, O.
Bailey Meter Company Ltd., Montreal, Canada

Republic Flow Meters
Simplex Valve & Meter
Taylor Inst. Cos.
Warrick Co.

### CONTROLLERS, AUTOMATIC, Float

Allen-Bradley Co.
Autocall Co.
Automatic Control Co.
Bailey Meter Co.
Bristol Co.
Builders-Providence
Campbell Co., J. A.
**Cash Co.**
**Clark Cooper Co.**
Climax Div.
Cutler-Hammer, Inc.
Davis Regulator Co.
Fischer & Porter
Fisher Governor
Foster Engg. Co.
Foxboro Co.
Frick Co.
Furnas Electric Co.
General Controls
Grove Regulator
Hagan Corp.
Hammel-Dahl Co.
Instruments Corp.
Kieley & Mueller
**Klipfel Mfg.**
Leupold & Stevens
Lumenite Co.
Magnetrol Inc.
Mason-Neilan Regulator
McAlear Mfg.
Mercoid Corp.
Mercon Regulator Co.
Minneapolis-Honeywell
Moore Products
Northern Equipment
Positel Mfg. Co.
Powers Regulator Co.
Republic Flow Meters
Ruggles-Klingemann
Schade Valve Mfg. Co.
Shallcross Controls
Simplex Valve & Meter
Spence Eng. Co., Inc.
Swartwout Co.
Tagliabue Div.
Taylor Inst. Cos.
Water Level Controls Co.

### CONTROLLERS. AUTOMatic, Flow

Ace Instrument
American Meter Co.
Arca Regulators, Inc.
Askania Regulator
Assoc. Valve & Engrg.
Automatic Temp. Control
Bailey Meter Co.
Barber-Colman Co.
Beck Co.
Bristol Co.
Brooke Engineering

(Continued)

Brooks Rotameter
Builders-Providence
Cash Co.
**Clark Cooper Co.**
Cook Electric
Cutler-Hammer, Inc.
Davis Regulator
Denver Fire Clay Co.
Electrimatic Corp.
Fischer & Porter
Fisher Governor
Ford Regulator Valve
Foster Engg. Co.
Foxboro Co.
Fulton Sylphon Co.
General Controls
General Regulator Corp.
G. M. Mfg. Co.
Grove Regulator
Gump Co., B.F.
Hagan Corp.
Hammel-Dahl Co.
Hays Corp.
Henszey Co.
Kates Co. W. A.
**Klipfel Mfg. Co.**
Leeds & Northrup Co.
Leslie Co.
Leupold & Stevens
Lumenite Co.
Magnetrol, Inc.
Mallory & Co.
Mason-Neilan Regulator
Mercon Regulator
Milton Roy Pumps
Minneapolis-Honeywell
Moore Products
North American Mfg.
Northern Equipment
Penn Ind. Inst.
Permutit Co.
Powers Regulator
Process Controls, Inc.
Proportioneers, Inc.
Republic Flow Meters
Revere Corp.
Robinette Co., W. C.
R-S Prod. Corp.
Schutte & Koerting
Shallcross Controls
Simplex Valve & Meter
Sparling, R.W.
Spence Eng. Co., Inc.
Tagliabue Div.
Taylor Inst. Cos.
Trimount Inst. Co.
Waterman Engineering
Wheelco Instruments
Wilgus Mfg. Co.

### CONTROLLERS, AUTOMATIC, Flow, Proportioning

Ace Instrument
American Meter Co.
Arca Regulators, Inc.
Askania Regulator Co.
Autocall Co.
Automatic Temp. Control
Bailey Meter Co.
Barber-Colman Co.
Beck Co.
Bristol Co.
Brooke Eng. Co.
Brooks Rotameter
Builders-Providence
Cash Co.
Connelly, Inc.
Cutler-Hammer, Inc.
Electronic Prod. Co.
Fischer & Porter
Fisher Governor
Foxboro Co.
Fulton Sylphon Co.
General Controls
General Regulator Corp.
Hagan Corp.
Hammel-Dahl Co.
Hays Corp.
Henszey Co.
Kates Co., W. A.
Klipfel Mfg. Co.
Lammert & Mann Co.
Lapp Insulator
Leeds & Northrup Co.
Leslie Co.
Mason-Neilan Regulator
McAlear Mfg. Div.
Mercon Regulator Co.
Milton Roy Co.
Minneapolis-Honeywell
North American Mfg.
Penn Ind. Inst. Co.
Proportioneers, Inc.
Republic Flow Meters Co.
Reynolds Gas Regulator
Robinette Co.
R-S Prod. Corp.
Sampsel Time Control
Schutte & Koerting
Shallcross Controls
Simplex Valve & Meter
Sparling R.W
**Spence Engr. Co., Inc.**
Tagliabue Div
Taylor Inst. Cos.
**Wallace & Tiernan**
Wheelco Inst. Co.

### CONTROLLERS, AUTOMATIC, Fluid Proportioning (See Controllers Automatic, Flow Proportioning)

### CONTROLLERS, AUTOMATIC, Frequency (See Regulators)

### CONTROLLERS, AUTOMATIC, Furnace

Abrams Instrument
Ace Instrument Co.
Arca Regulators, Inc.
Askania Regulator Co.
Assembly Products
Automatic Elec. Mfg. Co.
Automatic Temp. Control
Bailey Meter Co.
Barber-Colman Co.
Barnes Co., F. W. & J.

(Continued)

Beck Co.
Bristol Co.
Brooke Eng. Co.
**Burling Instrument Co.**
**Burrel Tech. Supply**
Cash Co.
Cleveland Fuel Equip.
Cook Electric Co.
Defender Automatic Reg.
Denver Fire Clay Co.
Dickson Co.
Electronic Prod. Co.
**Fischer & Porter**
Foxboro Co.
Fox Valley Inst.
Fuel Watchman
Fulton Sylphon Div.
General Controls
General Elec. Co.
General Regulator Corp.
Gleason-Avery, Inc.
Gordon Co., Claud S.
Hagan Corp.
Hammel-Dahl Co.
Hays Corp.
Leeds & Northrup
Lindberg Engineering
Macdonald Co., W.S.
Manning, Maxwell & Moore
Marsh Corp.
Mason-Neilan Regulator
McCorkle Co.
Mercoid Corp.
Minneapolis-Honeywell
National Airoil Burner
Partlow Corp.
Penn Electric Switch
Perfex Corp.
Pyrometer Inst. Co.
Republic Flow Meters
Robinette Co., W. C.
R-S Prod. Corp.
Ruggles-Klingermann
Sampsel Time Control
**Shallcross Controls**
Spence Engineering Co.
Taco West Corp.
Tagliabue Div.
Taylor Inst. Cos.
Thwing-Albert Inst. Co.
United Elec. Controls
Westinghouse Elec.
Wheelco Inst. Co.
White Mfg. Co.
White-Rodgers Electric
Wilgus Mfg. Co.

### CONTROLLERS, AUTOMATIC, Gas Density

Askania Regulator Corp.
Bailey Meter Co.
General Controls
General Power Plant
Hagan Corp.
Leeds & Northrup Co.
Moore Products
Refinery Supply Co.
Shallcross Controls

### CONTROLLERS. AUTOMATIC. Gas Mixing (See Controllers, Automatic, Flow Proportioning)

### CONTROLLERS. AUTOMATIC. Granular Material Level

Askania Regulator Co.
Bin-Dicator Co.
Builders-Providence
Electronic Prod. Co.
Fielden Instrument
Fuller Co.
General Controls
Gump Co., B. F.
Merrick Scale
Mosher Electronic
Photoswitch, Inc.
Robinette Co., W. C.
Shallcross Controls
Wheelco Instruments

### CONTROLLERS. AUTOMATIC. Granular Material Weight

Builders-Providence
Fielden Instruments
General Controls
Merrick Scale
Omega Machine
Photoswitch, Inc.

### CONTROLLERS. AUTOMATIC, Gravity

Arca Regulators, Inc.
Askania Regulator Co.
Bailey Meter Co.
Bristol Co.
Cash Co.
Ess Instrument
Foxboro Co.
Hagan Corp.
Hays Corp.
Leeds & Northrup Co.
Manning, Maxwell & Moore
Mason-Neilan Regulator
Mine & Smelter Supply
Moore Products
Precision Thermometer
Republic Flow Meters
Shallcross Controls
Tagliabue Div.
Taylor Inst. Cos.

### CONTROLLERS. AUTOMATIC, Humidity

American Inst. Co.
American Moistening Co.
Arca Regulators, Inc.
Atlas Valve Co.
Barber-Colman Co.
Barbender Corp.
Bristol Co.
Cramer & Co., Inc.
Dietert Co.
Electronic Engineers
Electronic Prod. Co.
Fenwal, Inc.
Fielden Inst.
Food Technology, Inc.

(Continued)

Foxboro Co.
Friez Instrument
Fuel Watchman
General Controls Co.
Gotham Inst. Co.
H-B Inst. Co., Inc.
Illinois Testing Labs.
Instrument Rep. & Mfg.
Instruments Corp.
Johnson Service Co.
Leeds & Northrup Co.
Manning, Maxwell & Moore
Mason-Neilan Regulator
Mine Safety Appliance
Minneapolis-Honeywell
Moeller Instrument Co.
Moisture Register Co.
Neomatic
Norcross Laboratories
Parks-Cramer Co.
Phen-Trols, Inc.
Phila. Thermometer Co.
Powers Regulator Co.
Rochester Mfg. Co.
Sampsel Time Control
Sarco Co., Inc.
Scientific Inst. Co.
Serdex, Inc.
Tagliabue Div.
Taylor Inst. Cos.
Tenney Engineering
Thwing-Albert Inst. Co.
Trerice Co., H. O.
United Elec. Controls
Valverde Labs.
Varo Mfg. Co.
Weksler Thermometer
Wheelco Insts. Co.
White-Rodgers Elec.
Zeiss, Inc., Carl

### CONTROLLERS, AUTOMATIC, Humidity and Temperature (See Controllers, Automatic Humidity and Controllers, Automatic, Temperature)

### CONTROLLERS, AUTOMATIC, Lighting

Abrams Instrument
Askania Regulator
Automatic Elec. Mfg.
Betts & Betts
Cutler-Hammer, Inc.
De-Tec-Tronic Labs.
Electronic Controls
Fisher-Pierce Co.
General Controls
General Elec. Co.
Lumenite Co.
Paragon Electric Co.
Photoswitch, Inc.
Rockwell Engr.
Sampsel Time Control
Superior Electric
Tork Clock
United Transformer
Ward Leonard Elec. Co.
Weston Elec. Inst. Corp.

### CONTROLLERS, AUTOMATIC, Liquid Level

Allen-Bradley Co.
American Meter Co.
Arca Regulators, Inc.
Askania Regulator Co.
Assoc. Valve & Engrg.
Atlas Valve Co.
Autocall Co.
Automatic Control Co.
Automatic Temp Control
Bailey Meter Co.
Barber-Colman
Bastian-Blessing Co.
Bin-Dicator Co.
Boylston Co.
Bristol Co.
Brooke Engineering
Builders Providence
B. W. Controller
Cash Co.
Clark Cooper Co.
Climax Div.
Conoflow Corp.
Control Corp.
Cook Electric
Cutler-Hammer, Inc.
Davis Reg. Co.
Defender Automatic Reg.
Elec. Indicator Co.
Electronic Prod. Co.
Farris Engineering
Fielden Instrument
Fischer & Porter
Fisher Governor Co.
Fisher-Pierce Co.
Ford Regulator Valve
Foster Engg. Co.
Foxboro Co.
Frick Co.
Fuller Co.
General Controls Co.
General Electric Co.
General Regulator Corp
Grove Regulator
Guardian Elec. Mfg. Co
Hagan Corp.
Hammel-Dahl Co.
Hays Corp.
Henszey Co.
Instruments Corp.
Instruments Rep. & Mfg.
Jo-Bell Products
Johnson Service Co.
Kieley & Mueller
Klipfel Mfg. Co.
L. A. B. Corp.
Leeds & Northrup Co.
Leslie Co.
Leupold & Stevens
Lumenite Electronic
Magnetrol, Inc.
Manning, Maxwell & Moore
Mason-Neilan Regulator
McAlear Mfg.
Mercoid Corp.
Mercon Regulator Co.
Minneapolis-Honeywell

(Continued)

"HEAT INERTIA" IN PROBLEMS OF AUTOMATIC CONTROL OF TEMPERATURE

By VICTOR BROIDA
Consulting Engineer and
Process Control Specialist,
PARIS, FRANCE

A new treatment, based on the concept of the "fictitious mass" of the heat-process unit under automatic control.

*Mathematical? Of course, but Dr. Broida's method can be mastered by anyone who has taken first-year differential equations. Many users have found it as handy as if they had the ENIAC at their disposal.*

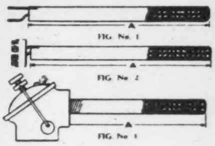
Stiff paper, 5¼ x 8¼ inches, 64 pages

$1.00 POSTPAID

Payment must accompany order

Instruments Publishing Co.
921 Ridge Ave. Pittsburgh 12, Pa.

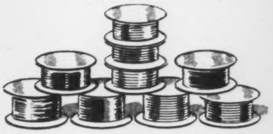
**IPS** for better Pyrometry



**THERMO-COUPLES**

*Insulated* THERMOCOUPLE LEAD WIRES

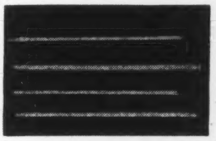
**THERMOCOUPLE HEADS**



**WIRES**

**INSULATORS**

—



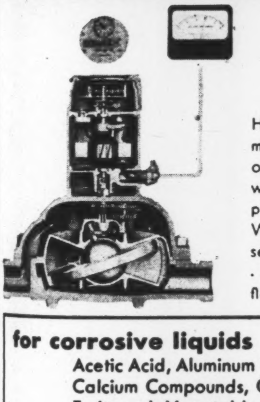
**TUBES**

WE MANUFACTURE OVER 58 TYPES OF INSULATED THERMOCOUPLE AND THERMOCOUPLE LEAD WIRE

**INDUSTRIAL PYROMETER & SUPPLY CO.**

ALTON, ILLINOIS

## Remote indication and control of liquid flow



Hays VERIFLOW meter accurately measures, indicates, and totals the flow of corrosive and hard-to-meter liquids without using weigh tanks, orifice plates, or gage sticks.
With the Hays VERITROL you simply set a knob at the rate of flow desired . . . then, the VERITROL *controls* the flow of liquid at that set-rate.

**for corrosive liquids**

Acetic Acid, Aluminum Potassium Sulphate, Ammonia, Calcium Compounds, Carbolic Acid, Formaldehyde, Fruit and Vegetable Juices, Hydrogen Peroxide, Phosphoric Acid, Potassium Hydroxide, Sodium Compounds, Sulphuric Acid (concentrated), Stearic Acid, and many others

*Send for a complete description of Hays Veriflow Meter and Veritrol. Bulletin 48-766*

**THE HAYS CORPORATION**

*MICHIGAN CITY 8A, INDIANA*

LIQUID LEVEL CONTROLS

- **Pump Controls**
- **Duplex Pump Alternators**
- **High and Low Level Cutoffs**
- **High and Low Level Alarms**
- **Multi-level Signals**
- **Liquid Metering**
- **Special Controls and Panels**

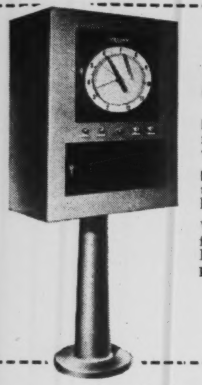
***Write For 32 Page Catalog***

**CHARLES F. WARRICK CO.**

1964 W. Eleven Mile Rd.
Berkley, Mich.

*Warrick*

FLOATLESS
LIQUID LEVEL CONTROLS
ELECTRODE TYPE



*Electronik* Recorders and Controllers for Textile and Paper Industries

**FOR TEXTILE.** Moist-O-Graph Controller measures and controls moisture content of warp to maintain any specified regain to within one-fourth of 1%. Adaptable to any type of slasher drive.

**FOR PAPER.** Moist-O-Graph Recorder supplies accurate and continuous record of sheet moisture content. Applicable to machines having speeds up to 2000 feet per minute.

Write for Instrumentation Data Sheets 8.1-4a, 8.1-27 and 8.1-37 for Textile and 2.9-5a for Paper. MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4579 Wayne Ave., Philadelphia 44, Pa.

MINNEAPOLIS
Honeywell
Brown Instruments

Moore Products Co.
Morey & Jones, Ltd.
**Natural Gas Equipment**
Norcross Corp.
Northern Equip. Co.
Panellit, Inc.
**Penn Electric Switch**
Penn Ind. Inst. Corp.
Petrometer Corp.
Photoswitch, Inc.
Positel Mfg. Co.
**Powers Regulators Co.**
Precision Therm.
**Reliance Guage Column**
**Republic Flow Meters**
**Robinette Co.**
**Rochester Mfg.** Co.
**Rockwell Engr.**
**R-S Products**
**Ruggles Klingmann**
**Sarco Co., Inc.**
**Schade Valve Mfg. Co.**
Shallcross Controls
**Simplex Valve & Meter**
Sparling, R. W.
**Spence Engineering** Co.
**Swartwout** Co.
**Tagliabue Div.**
Taylor Inst. Cos.
**Thermo Instruments**
Trimount Inst. Co.
(Continued)

Uehling Instrument Co.
United Electric Controls
Vapor **Recovery Sys.**
Warrick Co.
Water Level Controls Co.
Watts Regulator Co.
Wheelco Inst. Co.

**CONTROLLERS, AUTOMATIC, Load (See Regulators**

**CONTROLLERS, AUTOMATIC, Moisture (See Controllers, Automatic, Humidity)**

**CONTROLLERS, AUTOMATIC, PH**
Askania Regulator
Bailey Meter Co.
Beckman Insts.
Bristol Co.
Foxboro Co.
General Controls
Leeds & Northrup
Macbeth Corp.
Milton Roy Co.
**Minneapolis-Honeywell**
**Servomechanisms, Inc.**
Thwing-Albert Inst. Co.

**CONTROLLERS, AUTOMATIC, Phase (See Regulators)**

**CONTROLLERS, AUTOMATIC, Power Factor (See Regulators)**

**CONTROLLERS, AUTOMATIC, Pressure & Vacuum**
Ace Instrument Co.
Acme Regulator Co.
Aeromarine Inst. Co.
AiResearch Div.
Allen-Bradley Co.
American Meter Co.
Arca Regulators, Inc.
Askania Regulator Co.
Assoc. Valve & Engrg.
Atlas Valve Co.
Autocall Co.
Automatic Control Co.
Automatic Temp. Control
Bailey Meter Co.
Barber-Colman
Bastian-Blessing Co.
Beck Co.
Bockel & Co.
Boylston Co.
Bristol Co.
Brooke Eng. Co.
Builders-Providence
Clark Cooper Co.
Climax Div.
(Continued)

Conoflow Corp.
Cook Electric
Cutler-Hammer, Inc.
Davis Reg. Co.
Dennison Eng. Co.
Dickson Co.
Distillation Products
Douglass Automatic
Eclipse Fuel Engg.
Electronic Engineers
Electronic Prod Co.
Emerson Apparatus Co.
Emmett Machine
**Farris Engineering**
Fisher Governor Co.
Ford Reg. Valve Co.
Foster Engg. Co.
Foxboro Co.
Fredericks Co., George
Fuel Watchman
Fulton Sylphon Div.
Furnas Electric Co.
Gas Appl. Specialities
General Controls Co.
General Electric Co.
General Power Plant
General Regulator Corp.
Gotham Inst. Co.
Grove Regulator
Hagan Corp.
Hammel-Dahl Co.
(Continued)

**Hawk Tool Eng. Co.**
**Hays Corp.**
H & H Thermostats
Hoke, Inc.
Hydraulic Controls, Inc.
Ideal Lab. Tool
Instrument Rep. & Mfg.
Instruments Corp.
**Keckley Mfg. Co.**
**Kieley & Mueller**
**Klipfel Mfg. Co.**
Lammert & Mann Co.
**Leeds & Northrup Co.**
Leslie Co.
Manning, Maxwell, Moore
Marsh Corp.
Mason-Neilan Regulator
McAlear Mfg.
Meletron Corp.
Mercoid Corp.
Mercon Regulator Co.
Minneapolis-Honeywell
Moore Products
Mu-Switch Corp.
National Time & Signal
Natural Gas Equip. Inc.
Northern Equip. Co.
**Panellit, Inc.**
Penn Ind. Inst. Corp.
Perfex Corp.
Powers Regulator Co.
Precision Scientific
Precision Therm.
Process & Instruments
Republic Flow Meters
Revere Corp.
**Reynolds Gas Regulator**
**Rebinette Co., W. C.**
Rochester Mfg.
Rockwell **Engr.**
**Ruggles Klingemann**
Sampsel Time Control
**Schade Valve Mfg. Co.**
**Schwien Eng. Co.**
Scientific Inst. Co.
**Seely Instrument Co.**
**Selas Co.**
Shallcross Controls
Sinclair-Collins Valve
Skaneateles Mfg.
**Spence Engineering Co.**
**Squires Co.**
**Sterling Eng. Co.**
**Superior Controls**
**Swartwout Co.**
Tagliabue Div.
**Taller & Cooper**
Taylor Inst. Cos.
Trerice Co., H. O.
Trimount Inst. Co.
**United Elec. Controls**
Uehling Instrument Co.
**Vapor Recovery Systems**
Viking Instruments
**Wallace & Tiernan**
Ward Leonard Elec. Co.
(Continued)

Water Level Controls Co.
Wheelco Inst. Co.
White-Rodgers Electric
Yellow Springs Inst.

**CONTROLLERS, AUTOMATIC, Pyrometric**
**Am. Gas Furnace Co.**
Askania Regulator Co.
**Assembly Products**
Automatic Temp. Control
Bailey Meter Co.
Bristol Co.
Burling Inst. Co.
Dickson Co.
Electronic Prod. Co.
Engelhard, Chas.
Farris-Stacon
Ferner Co.
Foxboro Co.
Fox Valley Inst.
Fuel Watchman
General Elec. Co.
G-M Labs
Illinois Testing Labs.
Klipfel Mfg.
Leeds & Northrup Co.
Lewis-Engg. Co.
Loudon Insts.
Manning, Maxwell, Moore
Mason-Neilan Regulator
Minneapolis-Honeywell
Neomatic Inc.
Partlow Corp.
Perfex Corp.
Phen-Trols, Inc.
Pyrometer Instrument Co.
Pyrometer Service Co.
**Revere Corp.**
Robinette Co., W. C.
Rochester Mfg. Co.
Rockwell Engr. Co.
Squires Co.
Taco West Corp.
Tagliabue Div.
Taylor Inst. Cos.
Thwing-Albert Instrument
**Trerice Co., H. O.**
Uehling Instrument Co.
Victory Engr.
Wheelco Inst. Co.
Wilgus Mfg. Co.

**CONTROLLERS, AUTOMATIC, Radio Remote**
Automatic Elec. Chicago
Bristol Co.
El-Tronics, Inc.
Flader Inc., Fredric
Guardian Elec. Mfg. Co.
Hastings Inst. Co.
**Jacobs Instruments**
McFarlin Co.
**Metron Instrument**
Pacific Div.
**Polarad Electronics**
**Radio Receptor Co.**
**RCA Div.**
Schwien Engg. Co.
Servo Corp. of America
Sorensen & Co.
Summers Gyroscope
Wallace & Tiernan
Yardeny Engineering Co.

**CONTROLLERS, AUTOMATIC, Rate-Volume (See Controllers, Automatic, Flow)**

**CONTROLLERS, AUTOMATIC, Ratio**
Ahrendt Instrument
Askania Regulator
Bristol Co.
Hays Corp.
Industrial Electronics
Mason-Neilan Regulator
Proportioneers, Inc.
Research Control Inst. Co.
Tagliabue Div.

**CONTROLLERS, AUTOMATIC, Radio Remote**
Stewart Mfg. Co.

**CONTROLLERS, AUTOMATIC, Refrigeration**
Allen-Bradley Co.
Automatic Elec. Mfg.
Automatic Temp. Control
Burling Instrument Co.
Cash Co.
Cutler-Hammer, Inc.
Dickson Co.
Electrimatic Corp.
Flow Controls, Inc.
Foxboro Co.
Frick Co.
**Friez Instrument**
Fulton Sylphon Co.
General Controls Co.
General Elec. Co.
Hammel-Dahl Co.
Lumenite Elec. Co.
Magnetrol, Inc.
Manning, Maxwell, Moore
Mason-Neilan Regulator
McAlear Mfg. Co.
Mercoid Corp.
Minneapolis-Honeywell
Penn Electric Switch
Perfex Corp.
Phila. Thermometer Co.
Ranco, Inc.
Sarco Co., Inc.
Schade Valve Mfg. Co.
Skaneateles Mfg.
Tagliabue Div.
Taylor Inst. Cos.
Thermo Instruments
United Elec. Controls
White-Rodgers Electric

**CONTROLLERS, AUTOMATIC, RKVA (See Regulators)**

**CONTROLLERS, AUTOMATIC, Specific Gravity (See Controllers, Automatic, Gravity)**

*Second Edition (1951) Now Available*

Mechanical Measurements by Electrical Methods

Serialized in *Instruments* under the title
"Electric Gaging Methods"
By HOWARD C. ROBERTS
Special Research Associate Professor of Civil Engineering, University of Illinois (*for many years in Research Lab., A.R.A.*).

Typical of the comments received while this book ran as a serial in *Instruments*:

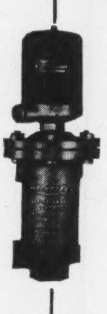
". . . I appreciate the thoroughness with which the subject is being treated." "We are sure that your articles will be widely read, for it is a subject certainly in need of the correlation you are giving it." ". . . I am glad to find that you have done so exhaustive a job on the subject."

Cloth, 368 pages, 4¾ x 8¼ inches; 254 illustrations; two bibliographies (500 refs.); seven-page index.

$4.00 postpaid

Remittance must accompany order

INSTRUMENTS PUBLISHING CO.
921 Ridge Ave., Pittsburgh 12, Pa.



MAGNETROL

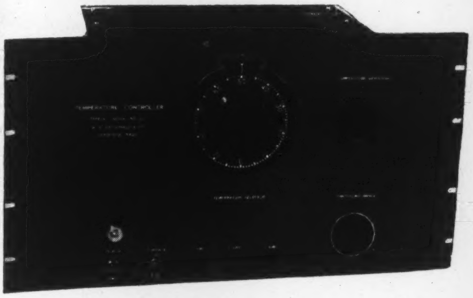
LIQUID LEVEL CONTROLS
for practically
ANY LIQUID
at any TEMPERATURE
at any PRESSURE

TANK FLOAT SWITCHES
- Top Mounting
- Side Mounting
- External Float Cage.

DIFFERENTIAL PRESSURE SWITCHES
FLOW SWITCHES
REFRIGERATION CONTROLS
OIL LEVEL ALARM RELAYS
BOILER WATER LEVEL CONTROLS
HIGH TEMPERATURE — HIGH PRESSURE UNITS
Write for complete Catalog

● MAGNETROL, INC.
2110 S. MARSHALL BLVD., CHICAGO 23

## MACDONALD PROPORTIONAL TEMPERATURE CONTROL



The THYRATRON Control allows PROPORTIONAL regulation of output power to electrically heated furnaces. Instead of turning current on-and-off, or adjusting the time of application of full power, the power level is continually monitored in accordance with the furnace demand. In this way the number of expansions and contractions of the heater elements is greatly reduced, increasing heater element life. The controller operates proportionally from a resistance thermometer, and thus insures maximum sensitivity of control.

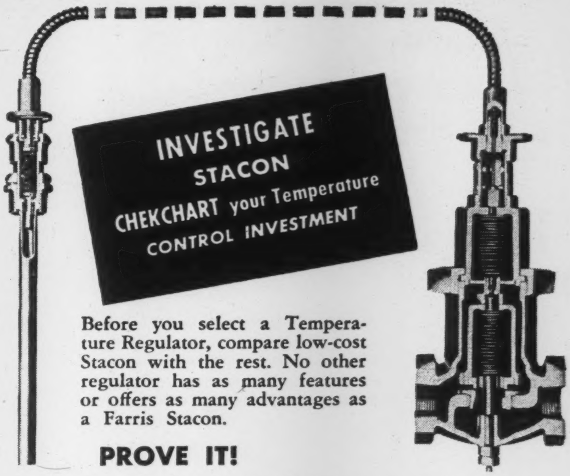
***Specifications:***

- Resistance Thermometer Actuated
- Controls up to 7½ amperes @ 220V
- Operates to 1000°C
- Controls to 0.1°C (0.01°C or better with improved furnaces)

**W. S. MACDONALD CO., INC.**

**University Rd., Cambridge, Massachusetts**

---



Before you select a Temperature Regulator, compare low-cost Stacon with the rest. No other regulator has as many features or offers as many advantages as a Farris Stacon.

**PROVE IT!**

***Make this Chekchart Test***

| | Farris Stacon | Air Operated | Self Operated |
|---|---|---|---|
| • Dirt Proof — Hermetically Sealed? | Yes | | |
| • Extreme Accuracy? | ±1° | | |
| • Packing or Glands to Leak? | No | | |
| • Drop-tight Shut off? | Yes | | |
| • Vapor-steam Energized Super Power Pilot? | Yes | | |
| • Supervision—Maintenance? | None | | |

Write for Stacon Bulletin 50-1000. It contains complete information on the most sensitive, accurate, economical temperature regulator available . . . anywhere.

**Farris Stacon Corp.**

**536 COMMERCIAL AVE. PALISADES PARK, N. J.**

---

## The *Gardsman*

**Pyrometric Temperature Controllers**

**MODEL J** Two position (off-on) controller. Reliable control. Requires no tuning or adjustment. Price $165.00. Write for Bulletin J-2.

**MODEL JP** Proportioning controller for fine control needed in exacting applications. Price $185.00. Write for Bulletin JP-1.

**MODEL JL** Limiting controller. This instrument may be used either as a safeguard or as an off-on controller as desired. Price $177.00 Write for Bulletin JL-1.

**Prices subject to change.*

**TACO WEST CORPORATION**

525 N. Noble St. Chicago 22, Ill.

---

**CONTROLLERS, AUTOMATIC, Speed** (See Tachometric below)

**CONTROLLERS, AUTOMATIC, Stoker** (See Controllers, Automatic, Furnace)

**CONTROLLERS, AUTOMATIC, Strain-Rate & Stress-Rate**

Bailey Meter Co.
Baldwin Locomotice
Hathaway Inst. Co.

**CONTROLLERS, AUTOMATIC, Synchronizing** (See Regulators)

**CONTROLLERS, AUTOMATIC, Tachometric**

Abrams Instrument
Allen-Bradley Co.
Askania Regulator Co.
Atomic Instrument
Automatic Temp. Control
Bailey Meter Co.
Barbour Stockwell Co.
Bristol Co.
Burlington Inst. Co.
Cutler-Hammer, Inc.
Electric Tachometer
Engineering Res. & Dev.
Flight Research Eng.
Foxboro Co.
General Elec. Co.
General Radio Co.
General Regulator Corp.
Hagan Corp.
Hays Corp.
Jones Motorola Corp.
Krohn-Hite Inst.
Leeds & Northrup
Lewis & Co., J. B.
Mason-Neilan Regulator
**Maxson Corp.**
Metron Instrument
Minneapolis-Honeywell
Moisture Register Co.
Monitor Controller Co.
Nankervis Co., G. L.
Potter Instrument
Republic Flow Meters
Robinette Co., W. C.
Rockwell Engr.
Servo Corp. of America
Servo-Tek Products
Servomechanisms
Shallcross Controls
Varo Mfg. Co.
Viking Instruments
Ward Leonard
Westinghouse Elec.

**CONTROLLERS, AUTOMATIC, Temperature** (See Pyrometric above or Thermometric below)

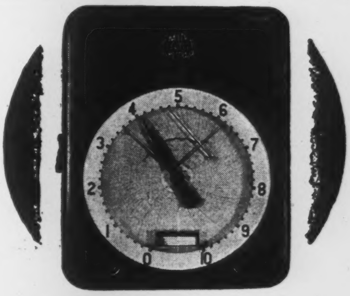
**CONTROLLERS, AUTOMATIC, Temperature-Time** (See Controllers, Automatic Thermometric; Controllers, Automatic, Thermostatic; Controllers, Automatic, Time)

**CONTROLLERS, AUTOMATIC, Thermometric**

AiResearch Div.
American Inst. Co.
Amer. Temp. Ind.
Assembly Products
Automatic Temp. Control
Bailey Meter Co.
Barber-Colman
Bristol Co.
Burling Inst. Co.
Clark-Cooper Co.
Commercial Research
Dickson Co.
Douglass Automatic
Edison Inc., Thomas A.
Electrimatic Corp.
Electro Medical Lab.
Electo-Tech. Equip.
Emerson Apparatus Co.
Emmett Machine
Farris-Stacon
Fisher Governor
Fish-Schurman Co.
Foster Engg. Co.
Foxboro Co.
Fuel Watchman
Fulton-Sylphon
General Controls
General Elec. Co.
General Regulator Corp.
Gotham Inst. Co.
Hagan Corp.
H-B Inst. Co., Inc.
Illinois Testing Labs.
Kessler Co.
Klipfel Mfg.
Leeds & Northrup
Leslie Co.
Manning, Maxwell & Moore
Marsh Corp.
Mason-Neilan Reg. Co.
McAlear Mfg. Co.
Minneapolis-Honeywell
Moeller Instrument Co.
Moisture Register Co.
Moore Products
Neomatic Inc.
Parks-Cramer Co.
Partlow Corp.
Phen-Trols Inc.
Powers Regulator
Precision Scientific
Precision Therm.
Refinery Supply Co.
Republic Flow Meters
Revere Corp.
Robinette Co., W. C.
Rochester Mfg. Co.

(Continued)

---



## BAILEY

## *Temperature Controller*

● This BAILEY PYROTRON Electronic Resistance Thermometer indicates, records and controls temperatures between −100 F and 1200 F.

As many as four continuous temperature records may be made on a single 12-inch diameter chart. The 29-inch indicating scale is read easily at distances up to fifty feet.

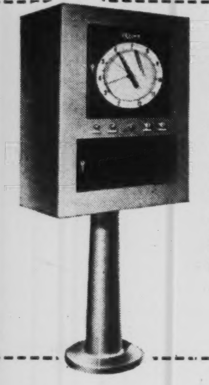
Two recording controllers may be combined in one Bailey Pyrotron to save panel space. Air-operated, electric, or electronic controls are furnished as required.

Each recorder responds instantly since it is controlled by a separate measuring bridge and inertia free electronic detector. A small reversible electric motor balances the bridge and drives the indicating, recording and controlling features.

The temperature sensitive element is a platinum resistance wire wound on a mica form.

Ask for Bulletin 230-B.

**BAILEY METER COMPANY**
1041 IVANHOE ROAD · CLEVELAND, O.
Bailey Meter Company Ltd. Montreal, Canada



*Electronik* Recorders and Controllers for Textile and Paper Industries

**FOR TEXTILE.** Moist-O-Graph Controller measures and controls moisture content of warp to maintain any specified regain to within one-fourth of 1%. Adaptable to any type of slasher drive.

**FOR PAPER.** Moist-O-Graph Recorder supplies accurate and continuous record of sheet moisture content. Applicable to machines having speeds up to 2000 feet per minute.

Write for Instrumentation Data Sheets 8.1-4a, 8.1-27 and 8.1-37 for Textile and 2.9-5a for Paper. MINNEAPOLIS-HONEYWELL REGULATOR Co., *Industrial Division*, 4579 Wayne Ave., Philadelphia 44, Pa.

MINNEAPOLIS **Honeywell**

Brown Instruments

Moore Products Co.
Morey & Jones, Ltd.
**Natural Gas Equipment**
Norcross Corp.
Northern Equip. Co.
Panellit, Inc.
**Penn Electric Switch**
Penn Ind. Inst. Corp.
Petrometer Corp.
Photoswitch, Inc.
Positel Mfg. Co.
Powers Regulators Co.
Precision Therm.
**Reliance Guage Column**
**Republic Flow Meters**
**Robinette Co.**
**Rochester Mfg.** Co.
**Rockwell Engr.**
**R-S Products**
**Ruggles Klingmann**
Sarco Co., Inc.
**Schade Valve Mfg. Co.**
Shallcross Controls
**Simplex Valve & Meter**
Sparling, R. W.
Spence Engineering Co.
**Swartwout Co.**
**Tagliabue Div.**
Taylor Inst. Cos.
Thermo Instruments
Trimount Inst. Co.

(Continued)

Uehling Instrument Co.
United Electric Controls
Vapor Recovery Sys.
Warrick Co.
Water Level Controls Co.
Watts Regulator Co.
Wheelco Inst. Co.

### CONTROLLERS, AUTOMATIC, Load (See Regulators

### CONTROLLERS, AUTOMATIC, Moisture (See Controllers, Automatic, Humidity)

### CONTROLLERS, AUTOMATIC, PH

Askania Regulator
Bailey Meter Co.
Beckman Insts.
Bristol Co.
Foxboro Co.
General Controls
Leeds & Northrup
Macbeth Corp.
**Milton Roy Co.**
**Minneapolis-Honeywell**
**Servomechanisms, Inc.**
Thwing-Albert Inst. Co.

### CONTROLLERS, AUTOMATIC, Phase (See Regulators)

### CONTROLLERS, AUTOMATIC, Power Factor (See Regulators)

### CONTROLLERS, AUTOMATIC, Pressure & Vacuum

Ace Instrument Co.
Acme Regulator Co.
Aeromarine Inst. Co.
AiResearch Div.
Allen-Bradley Co.
American Meter Co.
Arca Regulators, Inc.
Askania Regulator Co.
Assoc. Valve & **Engrg.**
Atlas Valve Co.
Autocall Co.
Automatic Control Co.
Automatic Temp. Control
Bailey Meter Co.
Barber-Colman
Bastian-Blessing Co.
Beck Co.
Bockel & Co.
Boylston Co.
Bristol Co.
Brooke Eng. Co.
Builders-Providence
Clark Cooper Co.
Climax Div.

(Continued)

Conoflow Corp.
Cook Electric
Cutler-Hammer, Inc.
Davis Reg. Co.
Dennison Eng. Co.
Dickson Co.
Distillation Products
Douglass Automatic
Eclipse Fuel Engg.
Electronic Engineers
Electronic Prod Co.
Emerson Apparatus Co.
Emmett Machine
**Farris Engineering**
Fisher Governor Co.
Ford Reg. Valve Co.
Foster Engg. Co.
Foxboro Co.
Fredericks Co., George
Fuel Watchman
Fulton Sylphon Div.
Furnas Electric Co.
Gas Appl. Specialities
General Controls Co.
General Electric Co.
General Power Plant
General Regulator Corp.
Gotham Inst. Co.
Grove Regulator
Hagan Corp.
Hammel-Dahl Co.

(Continued)

**Hawk Tool Eng. Co.**
**Hays Corp.**
H & H Thermostats
Hoke, Inc.
Hydraulic Controls, Inc.
Ideal Lab. Tool
Instrument Rep. & Mfg.
Instruments Corp.
**Keckley Mfg. Co.**
**Kieley & Mueller**
**Klipfel Mfg. Co.**
Lammert & Mann Co.
Leeds & Northrup Co.
Leslie Co.
Manning, Maxwell, Moore
Marsh Corp.
Mason-Neilan Regulator
McAlear Mfg.
Meletron Corp.
Mercoid Corp.
Mercon Regulator Co.
Minneapolis-Honeywell
Moore Products
Mu-Switch Corp.
National Time & Signal
Natural Gas Equip. Inc.
Northern Equip. Co.
**Panellit, Inc.**
Penn Ind. Inst. Corp.
Perfex Corp.
Powers Regulator Co.
Precision Scientific
Precision Therm.
Process & Instruments
Republic Flow Meters
Revere Corp.
**Reynolds Gas Regulator**
**Robinette Co., W. C.**
Rochester Mfg.
Rockwell Engr.
**Ruggles Klingemann**
Sampsel Time Control
**Schade Valve Mfg. Co.**
Schwien Eng. Co.
Scientific Inst. Co.
Seely Instrument Co.
**Selas Co.**
Shallcross Controls
Sinclair-Collins Valve
Skaneateles Mfg.
**Spence Engineering Co.**
Squires Co.
Sterling Eng. Co.
Superior Controls
Swartwout Co.
Tagliabue Div.
Taller & Cooper
Taylor Inst. Cos.
Trerice Co., H. O.
Trimount Inst. Co.
United Elec. Controls
Uehling Instrument Co.
Vapor Recovery Systems
Viking Instruments
Wallace & Tiernan
Ward Leonard Elec. Co.

(Continued)

Water Level Controls Co.
Wheelco Inst. Co.
White-Rodgers Electric
Yellow Springs Inst.

### CONTROLLERS, AUTOMATIC, Pyrometric

**Am. Gas Furnace Co.**
Askania Regulator Co.
Assembly Products
Automatic Temp. Control
Bailey Meter Co.
Bristol Co.
Burling Inst. Co.
Dickson Co.
Electronic Prod. Co.
Engelhard, Chas.
Farris-Stacon
Ferner Co.
Foxboro Co.
Fox Valley Inst.
Fuel Watchman
General Elec. Co.
G-M Labs
Illinois Testing Labs.
Klipfel Mfg.
Leeds & Northrup Co.
Lewis-Engg. Co.
Loudon Insts.
Manning, Maxwell, Moore
Mason-Neilan Regulator
Minneapolis-Honeywell
Neomatic Inc.
Partlow Corp.
Perfex Corp.
Phen-Trols, Inc.
Pyrometer Instrument Co.
Pyrometer Service Co.
**Revere Corp.**
Robinette Co., W. C.
Rochester Mfg. Co.
Rockwell Engr. Co.
Squires Co.
Taco West Corp.
Tagliabue Div.
Taylor Inst. Cos.
Thwing-Albert Instrument
**Trerice Co., H. O.**
Uehling Instrument Co.
Victory Engr.
Wheelco Inst. Co.
Wilgus Mfg. Co.

### CONTROLLERS, AUTOMATIC, Radio Remote

Automatic Elec. Chicago
Bristol Co.
El-Tronics, Inc.
Flader Inc., Fredric
Guardian Elec. Mfg. Co.
Hastings Inst. Co.
Jacobs Instruments
McFarlin Co.
**Metron Instrument**
Pacific Div.
**Polarad Electronics**
**Radio Receptor Co.**
RCA Div.
Schwien Engg. Co.
Servo Corp. of America
Sorensen & Co.
Summers Gyroscope
Wallace & Tiernan
Yardeny Engineering Co.

### CONTROLLERS, AUTOMATIC, Rate-Volume (See Controllers, Automatic, Flow)

### CONTROLLERS, AUTOMATIC, Ratio

Ahrendt Instrument
Askania Regulator
Bristol Co.
Hays Corp.
Industrial Electronics
Mason-Neilan Regulator
Proportioneers, Inc.
Research Control Inst. Co.
Tagliabue Div.

### CONTROLLERS, AUTOMATIC, Radio Remote

Stewart Mfg. Co.

### CONTROLLERS, AUTOMATIC, Refrigeration

Allen-Bradley Co.
Automatic Elec. Mfg.
Automatic Temp. Control
Burling Instrument Co.
Cash Co.
Cutler-Hammer, Inc.
Dickson Co.
Electrimatic Corp.
Flow Controls, Inc.
Foxboro Co.
Frick Co.
**Friez Instrument**
Fulton Sylphon Co.
General Controls Co.
General Elec. Co.
Hammel-Dahl Co.
Lumenite Elec. Co.
Magnetrol, Inc.
Manning, Maxwell, Moore
Mason-Neilan Regulator
McAlear Mfg. Co.
Mercoid Corp.
Minneapolis-Honeywell
Penn Electric Switch
Perfex Corp.
Phila. Thermometer Co.
Ranco, Inc.
Sarco Co., Inc.
Schade Valve Mfg. Co.
Skaneateles Mfg.
Tagliabue Div.
Taylor Inst. Cos.
Thermo Instruments
United Elec. Controls
White-Rodgers Electric

### CONTROLLERS, AUTOMATIC, RKVA (See Regulators)

### CONTROLLERS, AUTOMATIC, Specific Gravity (See Controllers, Automatic, Gravity)

*Second Edition (1951) Now Available*

Mechanical Measurements by Electrical Methods

Serialized in *Instruments* under the title "Electric Gaging Methods"

By HOWARD C. ROBERTS

Special Research Associate Professor of Civil Engineering, University of Illinois (*for many years in Research Lab., A.R.A.*).

Typical of the comments received while this book ran as a serial in *Instruments*:

". . . I appreciate the thoroughness with which the subject is being treated." "We are sure that your articles will be widely read, for it is a subject certainly in need of the correlation you are giving it." ". . . I am glad to find that you have done so exhaustive a job on the subject."

Cloth, 368 pages, 4¾ x 8¼ inches; 254 illustrations; two bibliographies (500 refs.); seven-page index.

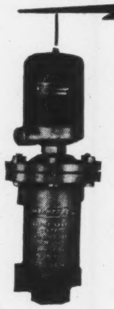
$4.00 postpaid

Remittance must accompany order

INSTRUMENTS PUBLISHING CO.

921 Ridge Ave., Pittsburgh 12, Pa.

MAGNETROL



LIQUID LEVEL CONTROLS for practically ANY LIQUID at any TEMPERATURE at any PRESSURE

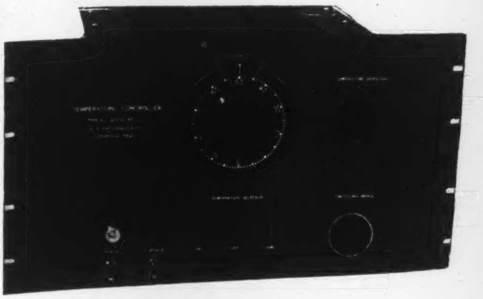
TANK FLOAT SWITCHES
- Top Mounting
- Side Mounting
- External Float Cage.

DIFFERENTIAL PRESSURE SWITCHES
FLOW SWITCHES
REFRIGERATION CONTROLS
OIL LEVEL ALARM RELAYS
BOILER WATER LEVEL CONTROLS
HIGH TEMPERATURE — HIGH PRESSURE UNITS

Write for complete Catalog

● MAGNETROL, INC.
2110 S. MARSHALL BLVD., CHICAGO 23

**MACDONALD PROPORTIONAL TEMPERATURE CONTROL**



The THYRATRON Control allows PROPORTIONAL regulation of output power to electrically heated furnaces. Instead of turning current on-and-off, or adjusting the time of application of full power, the power level is continually monitored in accordance with the furnace demand. In this way the number of expansions and contractions of the heater elements is greatly reduced, increasing heater element life. The controller operates proportionally from a resistance thermometer, and thus insures maximum sensitivity of control.

***Specifications:***
- Resistance Thermometer Actuated
- Controls up to 7½ amperes @ 220V
- Operates to 1000°C
- Controls to 0.1°C (0.01°C or better with improved furnaces)

**W. S. MACDONALD CO., INC.**
University Rd., Cambridge, Massachusetts

INVESTIGATE
STACON
CHEKCHART your Temperature
CONTROL INVESTMENT

Before you select a Temperature Regulator, compare low-cost Stacon with the rest. No other regulator has as many features or offers as many advantages as a Farris Stacon.

**PROVE IT!**

***Make this Chekchart Test***

| | Farris Stacon | Air Operated | Self Operated |
|---|---|---|---|
| • Dirt Proof — Hermetically Sealed? | Yes | | |
| • Extreme Accuracy? | ±1° | | |
| • Packing or Glands to Leak? | No | | |
| • Drop-tight Shut off? | Yes | | |
| • Vapor-steam Energized Super Power Pilot? | Yes | | |
| • Supervision—Maintenance? | None | | |

Write for Stacon Bulletin 50-1000. It contains complete information on the most sensitive, accurate, economical temperature regulator available . . . anywhere.

**Farris Stacon Corp.**
536 COMMERCIAL AVE. PALISADES PARK, N. J.

**The *Gardsman***
**Pyrometric Temperature Controllers**

**MODEL J** Two position (off-on) controller. Reliable control. Requires no tuning or adjustment. Price $165.00. Write for Bulletin J-2.

**MODEL JP** Proportioning controller for fine control needed in exacting applications. Price $185.00. Write for Bulletin JP-1.

**MODEL JL** Limiting controller. This instrument may be used either as a safeguard or as an off-on controller as desired. Price $177.00 Write for Bulletin JL-1.

**Prices subject to change.*

**TACO WEST CORPORATION**
525 N. Noble St. Chicago 22, Ill.

**CONTROLLERS, AUTOMATIC, Speed** (See Tachometric below)

**CONTROLLERS, AUTOMATIC, Stoker** (See Controllers, Automatic, Furnace)

**CONTROLLERS, AUTOMATIC, Strain-Rate & Stress-Rate**
Bailey Meter Co.
Baldwin Locomotice
Hathaway Inst. Co.

**CONTROLLERS, AUTOMATIC, Synchronizing** (See Regulators)

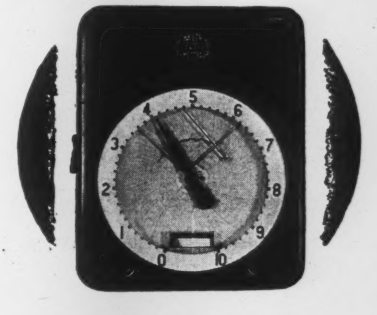
**CONTROLLERS, AUTOMATIC, Tachometric**
Abrams Instrument
Allen-Bradley Co.
Askania Regulator Co.
Atomic Instrument
Automatic Temp. Control
Bailey Meter Co.
Barbour Stockwell Co.
Bristol Co.
Burlington Inst. Co.
Cutler-Hammer, Inc.
Electric Tachometer
Engineering Res. & Dev.
Flight Research Eng.
Foxboro Co.
General Elec. Co.
General Radio Co.
General Regulator Corp.
Hagan Corp.
Hays Corp.
Jones Motorola Corp.
Krohn-Hite Inst.
Leeds & Northrup
Lewis & Co., J. B.
Mason-Neilan Regulator
**Maxson Corp.**
Metron Instrument
Minneapolis-Honeywell
Moisture Register Co.
Monitor Controller Co.
Nankervis Co., G. L.
Potter Instrument
Republic Flow Meters
Robinette Co., W. C.
Rockwell Engr.
Servo Corp. of America
Servo-Tek Products
Servomechanisms
Shallcross Controls
Varo Mfg. Co.
Viking Instruments
Ward Leonard
Westinghouse Elec.

**CONTROLLERS, AUTOMATIC, Temperature** (See Pyrometric above or Thermometric below)

**CONTROLLERS, AUTOMATIC, Temperature-Time** (See Controllers, Automatic Thermometric; Controllers, Automatic, Thermostatic; Controllers, Automatic, Time)

**CONTROLLERS, AUTOMATIC, Thermometric**
AiResearch Div.
American Inst. Co.
Amer. Temp. Ind.
Assembly Products
Automatic Temp. Control
Bailey Meter Co.
Barber-Colman
Bristol Co.
Burling Inst. Co.
Clark-Cooper Co.
Commercial Research
Dickson Co.
Douglass Automatic
Edison Inc., Thomas A.
Electrimatic Corp.
Electro Medical Lab.
Electo-Tech. Equip.
Emerson Apparatus Co.
Emmett Machine
Farris-Stacon
Fisher Governor
Fish-Schurman Co.
Foster Engg. Co.
Foxboro Co.
Fuel Watchman
Fulton-Sylphon
General Controls
General Elec. Co.
General Regulator Corp.
Gotham Inst. Co.
Hagan Corp.
H-B Inst. Co., Inc.
Illinois Testing Labs.
Kessler Co.
Klipfel Mfg.
Leeds & Northrup
Leslie Co.
Manning, Maxwell & Moore
Marsh Corp.
Mason-Neilan Reg. Co.
McAlear Mfg. Co.
Minneapolis-Honeywell
Moeller Instrument Co.
Moisture Register Co.
Moore Products
Neomatic Inc.
Parks-Cramer Co.
Partlow Corp.
Phen-Trols Inc.
Powers Regulator
Precision Scientific
Precision Therm.
Refinery Supply Co.
Republic Flow Meters
Revere Corp.
Robinette Co., W. C.
Rochester Mfg. Co.

(Continued)



**BAILEY**
***Temperature Controller***

● This BAILEY PYROTRON Electronic Resistance Thermometer indicates, records and controls temperatures between −100 F and 1200 F.

As many as four continuous temperature records may be made on a single 12-inch diameter chart. The 29-inch indicating scale is read easily at distances up to fifty feet.

Two recording controllers may be combined in one Bailey Pyrotron to save panel space. Air-operated, electric, or electronic controls are furnished as required.

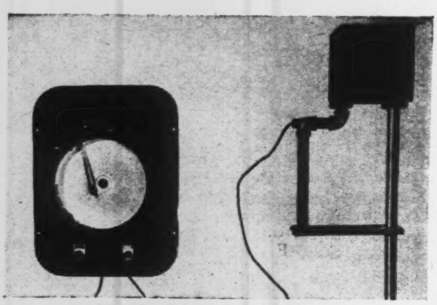
Each recorder responds instantly since it is controlled by a separate measuring bridge and inertia free electronic detector. A small reversible electric motor balances the bridge and drives the indicating, recording and controlling features.

The temperature sensitive element is a platinum resistance wire wound on a mica form.

Ask for Bulletin 230-B.

**BAILEY METER COMPANY**
1041 IVANHOE ROAD · CLEVELAND, O.
Bailey Meter Company Ltd., Montreal, Canada

**For Viscosity Process Control NORCROSS Recording and Recording Controlling Viscometers**



Viscosity Range: 1 to 200,000 c.p.

**Used in the Following Industries:**

Textiles
Plastics
Paper
Synthetics
Adhesives
Food Products
Petroleum
Syrups
Paints
Resins
Printing
Soap

**Can Be Used For:**

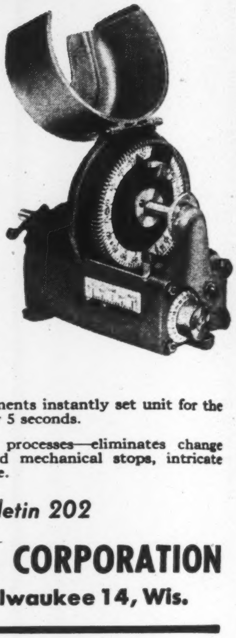
1. Recording or automatic control.
2. Operation under pressure or vacuum.
3. Explosion proof applications.

Write for booklet with photos and schematic drawings showing design and operation.

**NORCROSS CORPORATION**
247 Newtonville Ave., Newton 58, Mass.

**Design and Process Engineers:**

**Now! A RUGGED, PRE-DETERMINING COUNTER TO AUTOMATICALLY RE-CYCLE YOUR ELECTRIC CONTROL CIRCUITS**



**WHAT IT DOES:** The "Cyclo-Monitor" momentarily opens or closes electric circuits to motors, magnetic brakes, signals, relays, solenoids, etc., based on a predetermined count. Repeats automatically —no count reading, checking or manual re-setting between cycles.

**HOW IT OPERATES:** Count pickup may be *mechanical* (based on rotation or stroke), or *electric* (through sensitive switch, photo-electric cell, etc.).

**CONTROL RANGE:** May be set for *any count* from 1 to 2,000, and *all even numbers* from 2,000 to 4,000. Extended ranges also available.

**OPERATING SPEED:** *Rotary counter*—up to 5,000 counts per min.; *stroke counter*—up to 1,000 counts per min.; *solenoid-operated counter*—up to 350 counts per min. Intermittent or continuous operation. No pause for re-set.

**HOW CYCLE IS SET:** Two simple adjustments instantly set unit for the desired count. Can be set in approximately 5 seconds.

**ADVANTAGES:** Simplifies machines and processes—eliminates change gears, complicated cam systems, awkward mechanical stops, intricate control circuits, etc. Minimum set-up time.

*Write Now for Bulletin 202*

**COUNTER & CONTROL CORPORATION**
**5227 W. Electric Ave., Milwaukee 14, Wis.**

*Choice of top-flight research laboratories*

**ATOMIC'S**

**RESEARCH INSTRUMENTATION**

**Truly precise . . . built especially for fine research**

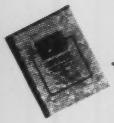
**SCALERS**

Ten-Ten "Building Block" Series. Choice of seven models with outstanding features complemented by standard modifications you can select.

**Linear Amplifiers**
Models 204B and 204C
Model 205 Preamplifier
**Coincidence Analyzer**
Model 502
Model 503 Anticoincidence
**Power Supply**
Models 306, 316 and 326

**Multiscaler**
Automatic—Model 1060
**Counting Rate Meters**
Models 409 and 410
**Scintillation Counter**
Model 223
**Pulse Height Analyzer**
Model 510

OTHER NEW INSTRUMENTS COMING



← *Write today for new illustrated, indexed catalog*

**ATOMIC INSTRUMENT COMPANY**
84 MASSACHUSETTS AVE. CAMBRIDGE 39, MASS.

Rubicon Co.
Scientific Inst. Co.
Spence Engineering Co.
Squires Co.
Stevens Mfg. Co.
Taco West Corp.
Tagliabue Div.
Taylor Inst. Cos.
Thwing-Albert Inst. Co.
Trerice Co.
United Elec. Controls
Valverde Labs.
Victory Engr.
Weksler Thermometer
Wheelco Inst. Co.
Wood. Harry W.

**CONTROLLERS, AUTOMATIC, Thermostatic**

Accuracy Scientific Inst.
AiResearch Div.
Allen-Bradley Co.
American Inst. Co.
Askania Regulator Co.
Atlas Valve Co.
Automatic Temp. Control
Bailey Meter Co.
Barber-Colman Co.
Betts & Betts
Bockel & Co.
Bristol Co.
Boiler Room Equip.
Burling Inst. Co.
Cook Electric Co.
Cramer & Co., Inc.
Cutler-Hammer Inc.
Dickson Co.
Doelcam Corp.
Edison Electrical Controls
Electric Hotpack Co.
Farris Stacon
Fenwal, Inc.
Fisher-Governor
Fish-Schurman Co.
Foster Eng. Co.
Foxboro Co.
Fuel Watchman
Fulton Sylphon Co.
General Controls Co.
General Elec. Co.
Gleason Avery, Inc.
Gotham Inst. Co.
G-V Controls Inc.
Hagan Corp.
Hammel-Dahl Co.
H-B Inst. Co.
H & H Themostats
Hart Mfg. Co.
Industrial Engr. Corp.
Instrument Rep. & Mfg.
Johnson Service Co.
Keckley Mfg. Co.
Kieley & Mueller
Klipfel Mfg. Co.
Leslie Co.
Manning, Maxwell, Moore
Marsh Corp.
Mercoid Corp.
Minneapolis-Honeywell
Moiture Register Co.
Mu-Switch Corp.
Partlow Corp.
Perfex Corp.
Phila. Thermometer Co.
Powers Regulator Co.
Precision Scientific
Precision Therm.
Preferred Utilities
Rascher & Betzold
Republic Flow Meters
Robinette Co., W. C.
Ruggles Klingemann
Sampsel Time Control
Sarco Co., Inc.
Smith Control & Inst.
Spence Engineering Co.
Sterling Inc.
Stevens Mfg. Co.
Struthers-Dunn
Swartwout Co.
Tagliabue Div.
Taylor Inst. Co.
Trerice Co.
United Elec. Controls
Valverde Labs.
Victory Engr.
Viking Instruments
Weston Elec. Inst. Corp.
White Mfg. Co.
White-Rodgers Elec. Co.

**CONTROLLERS, AUTOMATIC, Time**

Abrams Instrument
Allen-Bradley Co.
Am. Gas Accumulator
American Timer Corp.
Automatic Elec. Mfg. Co.
Automatic Temp. Control
Bailey Meter Co.
Barber-Colman
Betts & Betts
Bristol Co.
Cincinnati Time Rec.
Clare & Co.
Controls, Inc.
Counter & Control Corp.
Cramer Co., Inc.
Cutler-Hammer, Inc.
Dorothea Mechanisms, Gale
Eagle Signal Corp.
Edison Electrical Prods.
Electric Hotpack Co.
Electro-Physics Co.
Electronic Controls
Emmett Machine
Fisher Governor
Foxboro Co.
Fredericks Co., Geo.
Friez Instrument
Fuel Watchman
General Controls
General Elec. Co.
Gotham Inst. Co.
Guardian Electric Mfg.
G-V Controls Inc.
Hagan Corp.
Haydon Co., A. W.
Industrial Timer Corp.
Johnson Service Co.
Leeds & Northrup
Lumenite Electronic
Manning, Maxwell, Moore
Mason-Neilan Regulator
Minneapolis-Honeywell
Montgomery
National Time & Signal
Neomatic Inc.
Northwestern Clock Co.
Paragon Electric Co.
Partlow Corp.
Perfex Corp.
Photoswitch, Inc.
Photovolt Corp.
Potter Instrument
Powers Regulator Co.
Production Instrument
Rhodes, Inc., M. H.
Sampsel Time Control
Sangamo Elec. Co.
Seely Inst., Co., Inc.
Standard Elec. Time
Stromberg Time Corp.
Struthers-Dunn
Tagliabue Div.
Taylor Inst. Co.
Telechron, Inc.
Thomas Clock Co., Seth
Thordarson Elec. Mfg.
Tork Clock Co.
Wadsworth Elec. Mfg.
Walser Automatic Timer
Ward Leonard
Wheelco Insts. Co.
White-Rodgers Elec.
Wilson & Co., G. C.

**CONTROLLERS, AUTOMATIC, Torque**

Aero Electronics
Ahrendt, Instrument
Askania Regulator
Industrial Electronics
Vectron, Inc.

**CONTROLLERS, AUTOMATIC, Vacuum (See Controllers, Automatic, Pressure)**

**CONTROLLERS, AUTOMATIC, Viscosity**

Bailey Meter Co.
Brabender Corp.
Brookfield Engg. Labs.
Electric Eye Equip.
Fischer & Porter
Foxboro Co.
General Controls
General Elec Co.
Norcross Corp.
Perfex Corp.

(Continued)

Robinette Co.
Scientific Inst. Co.
Taylor Inst. Cos.
Visco-Meter Corp.

### CONTROLLERS, AUTOMATIC, Voltage (See Regulators)

### CONTROLLERS, AUTOMATIC, Volume (See Controllers, Automatic, Flow)

### CONTROLLERS, AUTOMATIC, Water Level (See Controllers, Automatic, Liquid Level)

### CONTROLLERS MANUAL (Non-automatic), Field

Allis-Chalmers
Automatic Elec. Mfg.
Betts & Betts
Climax Engineering
Cutler-Hammer, Inc.
General Controls
General Elec. Co.
National Elec. Controler
Ohmite Mfg. Co.
Ward Leonard Elec. Co.
Westinghouse Elec.

### CONTROLLERS MANUAL (Non-automatic), Hydaulic

Adel Precision Prods.
Brooks Rotameter
Cash Co.
General Controls
Hagan Corp.
Hammel-Dahl Co.
Hydraulic Controls
Schade Valve Mfg. Co.
Seely Inst. Co., Inc.
Shallcross Controls

### CONTROLLERS, MANUAL (Non-automatic) Motor

Allen-Bradley Co.
Allis-Chalmers
Automatic Elec. Mfg.
Betts & Betts
Cutler-Hammer, Inc.
Furnas Electric Co.
General Controls
General Elec. Co.
Heller Co.
Leeds & Northrup
Lindberg Engineering
National Elec. Controler
Ohmite Mfg. Co.
Superior Electric Co.
Ward Leonard Elec. Co.
Westinghouse Elec. & Mfg.
Wilson & Co.

### CONTROLLERS, MANUAL, (Non-automatic) Pneumatic

Bristol Co.
Climax Div.
Mason-Neilan Regulator
Powers Regulator Co.
Research Control Inst.

### CONTROLLERS, MANUAL (Non-automatic Rheostatic)

Allen-Bradley Co.
Beck Bros.
Cutler-Hammer, Inc.
General Controls
General Elec. Co.
Mallory & Co.
National Elec. Controller
Ohmite Mfg. Co.
Rubicon Co.
Ward Leonard Elec. Co.
Westinghouse Elec.

### CONTROL SYSTEMS (See Controllers, Automatic)

### COUNTERS, Alarm

Adde & Co.
Automatic Temp. Control
Counter & Control Corp.
Cook Electric
Durant Mfg. Co.
El-Tronics, Inc.
Flett Laboratory
General Electric Co.
Martin-Hubbard Corp.
Mercoid Corp.
Potter Instrument
Production Instrument
Rowe Engineering
Veeder-Root

### COUNTERS, BATCH, Automatic Electric Predetermined

Automatic Temp. Control
Berkeley Scientific
Cole Instrument
Durant Mfg. Co
Eagle Signal
Genisco Inc.
Hetherington, Inc.
Nucleonic Corp.
Post Machinery
Potter Instrument
R-C Scientific Inst.
Richardson Scale
Standard Elec. Time

### COUNTERS, Colony

American Optical
Central Scientific
Fisher Scientific Co.
Sargent & Co.
Thomas Co., Arthur H.

### COUNTERS, Cycle

Automatic Elec. Chicago
Automatic Temp. Control
Bawden Bros.
Berkeley Scientific
Bristol Co.
Brush Development
Cook Electric
Counter & Control Corp.
Cyclotron Specialities Co.
Dittmore & Freimuth
Dorothea Mechanisms, Gale
Electric Speed Indicator
Engineering Res. Assoc.
Foxboro Co.
General Elec. Co.
Gorrell & Gorrell
Hetherington Inc.
Hewlett-Packard Co.
Martin-Hubbard Corp.
Minnesota Electronics
Paragon Electric Co.
Potter Instrument
Raytheon Mfg. Co.
Standard Elec. Time Co.
States Co.
Stoelting Co., C. H.
Telechron, Inc.
Walkirt Co.
Westinghouse Elec.

### COUNTERS, Footage

Adde & Co.
Bristol Co.
Cook Electric
Counter & Control Corp.
Dittmore & Freimuth
Durant Mfg. Co.
Elec. Tachometer Corp.
Hetherington Inc.
McDonnell Odometer Corp.
Nucleonic Corp.
Potter Instrument
Production Instrument
Veeder-Root, Inc.
Zernikow Co.

### COUNTERS, Geiger-Muller

Abrams Instrument
American Instrument
Atomic Instrument
Berkeley Scientific
Cambridge Inst. Co.
Canadian Radium
Coulter Electronics
Cyclotron Specialties
Detectron Co.
Distillation Products
Douglas Radio Labs.
Eck & Krebs
Eclipse-Pioneer
Electronic Products
El-Tronics, Inc.
Flader, Inc., Frederic
Flett Laboratory
General Electric
General Radio Co.
Geophysical Instrument
Goldak Co.
Herbach & Rademan
Inst. Development Labs.
Kelley-Koett Inst. Div.
Menlo Research Lab.
Morgan Instrument
National Tech. Labs.
North Amer. Philips
Nuclear Dev. Lab.
Nuclear Inst. & Chem.
Nuclear Research & Dev.
Potter Instrument
Radiation Counter Labs.
Radioactive Products
R-C Scientific Inst.
Southwestern Ind. Elec.
Stoelting Co., C. H.
Stratex Instrument Co.
Sylvania Elec. Prod.
Technical Associates
Tracerlab, Inc.
Ultra-Violet Products
Universal X-Ray Products
Vacutron, Inc.
Victoreen Instrument Co.
Welch Scientific
Wood Counterlab

### COUNTERS, High Speed

Abrams Instrument
Ahrendt Instrument
Berkeley Scientific
Cole Instrument
Durant Mfg. Co.
Engineering Res. Assoc.
Hetherington Inc.
Hewlett-Packard
Jacobs Instr. Co.
Metrotype Corp.
Post Machinery Co.
Potter Instrument Co.
Special Instruments Lab.
Stoelting Co., C. H.
Stratex Instrument Co.
Telecomputing Corp.
Walkirt Co.

### COUNTERS, Hour

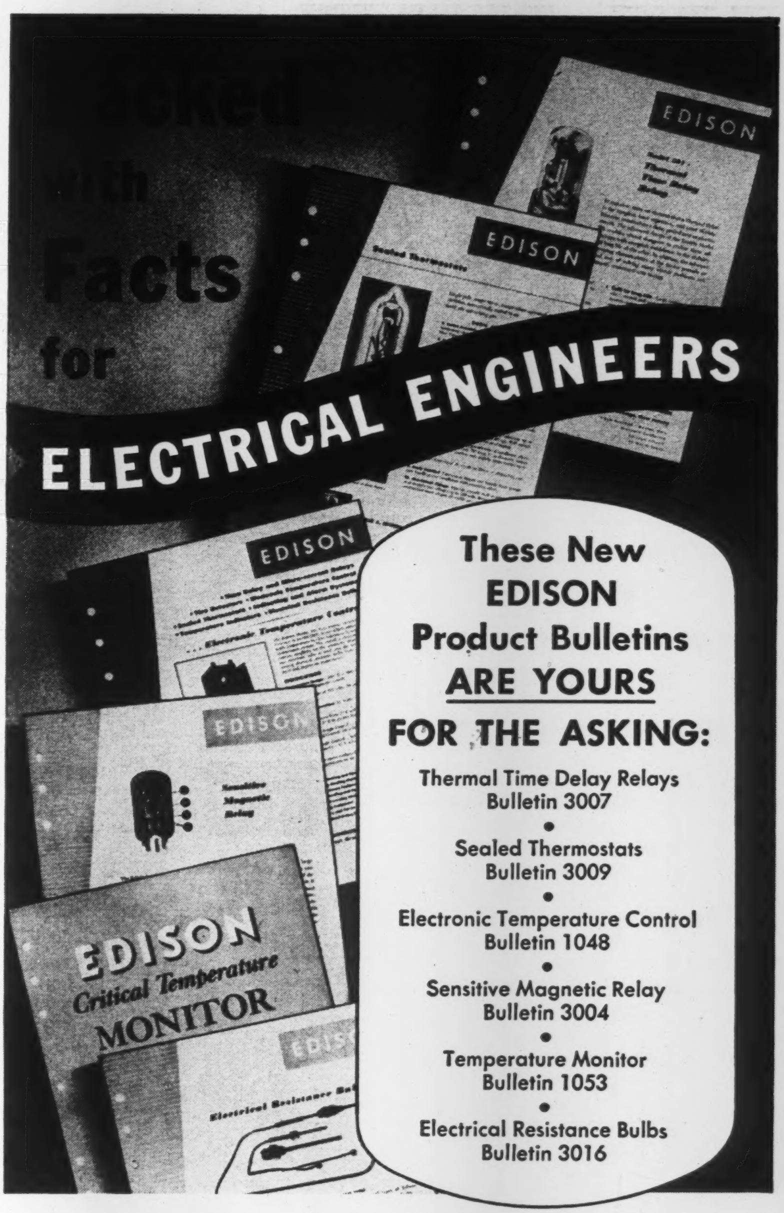
Aero Instrument
Alina Corp.
Automatic Temp. Control
Cramer & Co., Inc.
Elec. Tachometer Corp.
General Elec. Co.
Gorrell & Gorrell
Haydon Co., A. W.
Marion Inst.
Paragon Electric Co.
Phillips Petroleum
Production Instrument
Revere Corp.
Standard Elec. Time
Telechron, Inc.
Veeder-Root
Westinghouse Elec.
Weston Elec. Inst. Corp.

### COUNTERS, Lumber

Adde & Co.
Dittmore & Freimuth
Durant Mfg. Co.
Keuffel & Esser Co.
Lufkin Rule Co.
McDonnell Odometer Co.
Moisture Register Co.
Potter Instrument
Production Instrument

### COUNTERS, Photoelectric

Atomic Instrument
Autotron Co.
Berkeley Scientific



These New
EDISON
Product Bulletins
ARE YOURS
FOR THE ASKING:

Thermal Time Delay Relays
Bulletin 3007
•
Sealed Thermostats
Bulletin 3009
•
Electronic Temperature Control
Bulletin 1048
•
Sensitive Magnetic Relay
Bulletin 3004
•
Temperature Monitor
Bulletin 1053
•
Electrical Resistance Bulbs
Bulletin 3016

Every one of these Bulletins contains highly useful information, data, graphs and schematic diagrams specially prepared for the electrical engineer. Write us today, listing the Bulletins you want, and they will be sent to you promptly and absolutely free.

Thomas A. Edison
INCORPORATED
INSTRUMENT DIVISION
West Orange • New Jersey

YOU CAN ALWAYS RELY ON EDISON

THE COMPASS THAT HAS MADE VEMCO FAMOUS
Look for the Red Dots
No. C-110 6½" Bow Compass

VEMCO "open truss" design gives you the strongest, most accurate and most durable draftsman's compass obtainable.

With these instruments you can describe the finest pen line or the heaviest pencil drawing with absolute precision.

In addition VEMCO compasses give you greater capacity. The No. C-110 6½" compass, for example, gives you a range from ⅛ inch to 10 inches.

Irrespective of price, you cannot buy greater accuracy than the VEMCO. Ask your VEMCO dealer for a demonstration or write today for illustrated literature.

**V. & E. MANUFACTURING CO.**
Pasadena 20, California

ASK TO SEE THE COMPLETE VEMCO LINE
Drafting Machines
Drawing Sets
Compasses
Microliner Ruling Pens

Detect-O-Ray
De-Tec-Tronic Labs
Dittmore & Freimuth
Durant Mfg. Co.
Electro-Physics Co.
Electronic Prod. Co.
El-Tronics, Inc.
Engineering Res. & Dev.
Ess Instrument Co.
Fisher-Pierce Co.
Flett Lab.
General Electric Co.
Lumenite Electronic
Magnetic Amplifiers
Martin-Hubbard Corp.
Menlo Research Lab.
Photoswitch, Inc.
Post Machinery
Potter Instrument
Production Instrument
Rockwell Engr.
R-C Scientific Inst.
Sherron Metallic
Sticht Co.
Streeter-Amet Co.
Telecomputing Corp.
Vacutron, Inc.
Veeder-Root, Inc.
Walkirt Co.
Weston Electrical Inst.
Worner Products

### COUNTERS, Production

Abrams Instrument
Adde & Co.
Alina Corp.
Atomic Instrument
Automatic Elec. Chicago
Autotron Co.
Berkeley Scientific
Bristol Co.
Cincinnati Time Recorder
Clarkstan Corp.
Clay-Adams Co.
Cook Electric
Counter & Control Corp.
Cramer & Co., Inc.
Cyclotron Specialties
Detect-O-Ray
Dittmore & Freimuth
Dorothea Mechanisms, Gale
Durant Mfg. Co.
Elec. Tachometer Corp.
Electronic Controls
Engr. Research & Dev.
General Electric Co.
Gorrell & Gorrell
Guardian Elec.
Hart Mfg. Co., R. E.
Hetherington Inc.
Instrument Lab., Inc.
Krohn-Hite Inst.
Lansing Engineering
McDonnell Odometer Co.
Moisture Register Co.
Potter Instrument

(Continued)

Production Inst. Co.
Redington Co.
Richardson Scale Co.
Rowe Radio Research
Shallcross Mfg.
Standard Elec. Time
Streeter-Amet Co.
Struthers Dunn
Veeder-Root, Inc.
Walkirt Co.

### COUNTERS, Radiation

Berkeley Scientific
Clarkstan Corp.
Detectron Co.
Douglas Radio Labs.
General Electric
General Radio
Georator Corp.
MacDonald Co., W. S.
Nuclear Dev. Lab.
Nuclear Inst. & Chem.
Nuclear Res. & Dev.
Nucleonic Corp.
Potter Instrument
Radiation Counter Labs.
Radioactive Products
R-C Scientific Inst.
Special Insts. Lab.
Stratex Instrument
Tracerlab
Walkirt Co.
Western Radiation Lab.
Wood Counterlab

### COUNTERS, Recording

Berkeley Scientific
Dittmore & Freimuth
Durant Mfg. Co.
Nucleonic Corp.
Potter Instrument Co.
Radiation Counter Labs.
R-C Scientific Inst.
Richardson Scale Co.
Special Instruments Lab.
Stratex Instrument Co.
Western Radiation Lab.

### COUNTERS, Revolution

Adde & Co.
Associated Research
Automatic Temp. Control
Berkeley Scientific
Bristol Co.
Boulin Instrument Corp.
Brown & Sharpe
Cook Electric
Counter & Control Corp.
Cummings Machine Wks.
Cyclotron Specialities
Dittmore & Freimuth
Durant Mfg. Co.
Elec. Tachometer Corp.
Engr. Research & Dev.
General Electric
General Radio
Genisco Inc.

(Continued)

Gurley, W. & L. E.
Hart Mfg. Co., R. E.
Ideal Commutator
Industrial Timer Corp.
Jaeger Watch Co.
Jones Motorola Corp.
Knopf Instrument
Krohn-Hite Inst.
Mason-Neilan Regulator
McDonnell Odometer Co.
Millers Falls
Moisture Register Co.
Potter Instrument
Production Inst. Co.
Redington Co.
Scherr Co., Inc., George
Standard Elec. Time Co.
Starrett Co., L. S.
Taller & Cooper
Veeder-Root, Inc.
Walkirt Co.
Warren-Knight Co.
Zernickow Co., O.

### COUNTERS, Scintillation

Berkeley Scientific
Douglas Radio Labs.
General Electric
Hewlett Packard
MacDonald Co., W. S.
Nuclear Research & Dev.
Nucleonic Corp.
Radiation Counter Labs.
R-C Scientific Inst.
Stratex Inst.
Telecomputing Corp.
Tracerlab
Western Radiation Lab.
Wood Counterlab

### COUNTERS, Stroke

Adde & Co.
Automatic Temp. Control
Berkeley Scientific
Bristol Co.
Clay-Adams Co.
Cook Electric
Counter & Control Corp.
Dittmore & Freimuth
Dorothea Mechanisms, Gale
Durant Mfg. Co.
Eagle Signal Corp
Engr. Research & Dev.
Gorrell & Gorrell
Guardian Elec. Mfg. Co.
Hart Mfg. Co., R. E.
Impact Register
International Register Co.
McDonnell Odometer Co.
Moisture Register Co.
Potter Instrument
Production Inst. Co.
Redington Co.
Streeter-Amet Co.
Taller & Coper
Veeder-Root, Inc.
Walkirt Co.

### COUNTERS, Twist

Dittmore & Freimuth
McDonnell Odometer Co.
Potter Instrument
Scott Testers, Inc.
Suter, Alfred
Veeder -Root. Inc.

### COUNTERS, Vehicular

Aero Instrument
Aristo Import Co.
General Electric
Knopf Instrument
Streeter-Amet Co.
Taller & Cooper
Veeder-Root, Inc.

### COURSE PROTRACTORS (See Protractors, Course)

### CRYSTALS, Piezoelectric

Bausch & Lomb Opt.
Bliley Electrical Co.
Brush Development Co.
Crystal Research Labs.
Dearborn Scientific
General Elec. Co.
General Radio Co.
Gulton Mfg.
Knights Co.
North Amer. Philips
Premier Crystal Labs.
RCA Div
Reeves Hoffman Corp.
Standard Arcturus
Standard Piezo Co.
Valpey Crystals

### CRYSTALS, Quartz

Bliley Electric Co.
Crystal Research Labs.
Dearborn Scientific
Fecker, Inc.
Federal Telegraph Co.
Flett Laboratory
Fuess, Inc.
General Elec. Co.
General Radio Co.
Harvey Radio Labs.
Knights Co.
North Amer. Philips
Premier Crystal Labs.
RCA Div.
Reeves Hoffman Corp.
Standard Arcturus
Standard Piezo Co.
Unertl Optical Co.
Valpey Crystal Corp.
Western Electric

### CRYSTALS, Rochelle Salt

Brush Development Co.
Dearborn Scientific
Fecker, Inc.
Unertl Optical Co.
Wallace & Tiernan

### CRYSTALS, Tourmaline

Dearborn Scientific
Flecker, Inc.
Fuess, Inc.
Premier Crystal Labs.
Unertl Optical Co.
Valpey Crystal Corp.
Zeiss, Inc., Carl

### CUBIC FOOT BOTTLES (See Bottles, Cubic Feet)

### CUBICLES (See Control Boards, Weatherproof Housings, etc.)

### CURRENT LIMITERS

Betts & Betts
Bradley Laboratories
Burndy Engineering
Edison, Inc. Thomas
Fisher-Pierce Co.
General Elec. Co.
G-V Controls Inc.
Hagan Corp.
RCA Manufacturing
Thordarson Elec. Mfg.
Victory Engr.

### CURRENT METERS (See Meters, Current)

### CURRENT REGULATORS (See Regulators, Current)

### CURVE TRACERS (See Drawing Instruments)

### CUTMETERS

Amthor Testing Inst. Co.
Elec. Tachometer Corp.
McDonnell Odometer Co.
Veeder-Root, Inc.
Zernickow, O.

### CYCLE CONTROLLERS (See Controllers, Automatic, Cycle)

### CYCLE COUNTERS (See Counters, Cycle)

### CYCLOMETERS

Veeder-Root, Inc.

### CYLINDERS, GRADUATED (See Apparatus Laboratory, Glass)

### DECELEROMETERS (See Accelerometers)

### DECIBEL METERS See Sound Level Meters)

### DEEP SEA INSTRUMENTS

Ballauf Mfg. Co.
G. M. Mfg. Co.
Kahl Scientific Inst.
Moeller Inst. Co.
Pacific Div.
Trimount Inst. Co.
Varo Mfg. Co.

### DEFLECTION TESTERS, Light Wave See Testers, Deflection, Light Wave)

### DEFORMETERS

Baldwin Locomotice
Dietert Co.

### DEHYDRATORS, Instrument Air (See Dryers, Instrument Air)

### DELINEASCOPES

Beseler Co., Charles

### DEMAND, Indicators (See Meters, Demand, Electric; Meters, Demand, Gas)

### DEMAND, Recorders (See Meters, Demand)

### DENSIMETERS

Foxboro Co.
Natl. Aluminate Corp.
Permutit Co.
Pfaltz & Bauer, Inc.
Precision Thermometer
Tagliabue Div.

### DENSITOMETERS

Agfa Ansco
Applied Research Labs.
Baird Associates
Bausch & Lomb Opt.
Biddle Co., James G.
Cambridge Instrument
Dearborn Scientific
Eastman Kodak Co.
Ferner Co.
Fish-Schurman Corp.
Fisher Scientific
Gaertner Scientific Corp.
General Elec. Co.
Hayes Scientific
Jarrell-Ash Co.
Mico Inst. Co.
Permutit Co.
Photovolt Corp.
Precision Thermometer
Rockwell Engr.
Vectron, Inc.
Weston Elec. Inst.

### DENSOMETERS

Dearborn Scientific
Gaertner Scientific Corp.
Gurley, W. & L. E.
Permutit Co.
Weksler Thermometer
Zeiss, Inc., Carl

### DEPTH INDICATORS, Dimensional

Amer. Measuring Insts.
Chicago Dial Ind. Co.
Federal Prod. Corp.
Gen. Engg. & Model Wks.
Lufkin Rule
Maveg Machine Sales
Rimat Co.
Size Control Co.

### DEPTH INDICATORS, Sea

G. M. Mfg. Co.
Gulton Mfg.
Hagan Corp.
Kahl Scientific Inst.
Moeller Inst. Co.
Negus, T. S. & J. D.
Pacific Div.
Trimount Inst. Co.

### DEPTH, Recorders, Liquid (See Gages, Liquid Level, Indicating)

### DETECTOR CARS, For Testing Rails in Track

Sperry Products, Inc.

### DETECTORS, Alpha

Abrams Instrument
Clarkstan Corp.
General Electric
General Radio
Kelley-Koett Inst. Div.
Loudon Insts.
MacDonald Co., W. S.
Nuclear Development Lab.
Nuclear Inst. & Chemical
Nuclear Res. & Dev.
Nucleonic Corp.
Radiation Counter Labs.
Radioactive Products
R-C Scientific Inst.
Special Instruments Lab.
Technical Associates
Tracerlab
Wood Counterlab

### DETECTORS, Benzol

Baird Associates
Bristol Co.
Davis Emergency Equip.
Mine Safety Appliances

### DETECTORS, Beta

Detectron Co.
General Electric
General Radio
Georator Corp.
Kelley-Koett Inst. Div.
Loudon Insts.
MacDonald Co., W. S.
Nuclear Development Lab.
Nuclear Inst. & Chemical
Nuclear Res. & Dev.
Nucleonic Corp.
Radiation Counter Labs.
Radioactive Products
R-C Scientific Inst.
Special Insts. Lab.
Technical Associates
Tracerlab
Western Radiation Lab.
Wood Counterlab

### DETECTORS, Carbon Monoxide

Baird Associates
Bristol Co.
Davis Emergency Equip.
Mine Safety Appliances
Taller & Coper

### DETECTORS, Combustible Gas

Bailey Meter Co.
Baird Associates
Bristol Co.
General Electric Co.
Johnson-Williams, Ltd.

### DETECTORS, Fire

Airite Products Co.
American Communications
Clark Cooper Co.
Edison, Inc., Thos. A.
Fenwal, Inc.
G-V Controls
Photoswitch, Inc.

### DETECTORS, Flaw

Aero Electronics
Branson Instrument
Dice Co., J. W.
Magnaflux Corp.
Magnetic Analysis Corp.
Sperry Products, Inc.

### DETECTORS, Gamma

Beckman, Inc. Arnold O.
Consolidated Engr.
Detectron Co.
General Electric
General Radio
Georator Corp.
Kelley-Koett Inst. Div.
Loudon Insts.
MacDonald Co., W. S.
Menlo Research Lab.
Nuclear Development Lab.
Nuclear Inst. & Chemical
Nuclear Res. & Dev.
Nucleonic Corp.
Radiation Counter Labs.
Radioactive Products
R-C Scientific Inst.
Special Insts. Lab.
Technical Associates
Tracerlab
Western Radiation Lab.
Wood Counterlab

### DETECTORS, Gas

Baird Associates
Beckman, Inc., Arnold O.
Bristol Co.
Bullard Co.
Davis Emergency Equip.
General Elec. Co.
Heiland Research
Johnson-Williams
Mine Safety App. Co.
Nuclear Inst. & Chem.
Process & Instruments
Victory Engr.

### DETECTORS, Hazardous or Poisonous Gas

Davis Instruments
Johnson-Williams Ltd.
Mine Safety Appliances
Technical Associates

### DETECTORS, Hydrogen Sulphide

Baird Associates
Davis Emergency Equip.
General Elec. Co.
Mine Safety Appliances

### DETECTORS, Infrared

Hillyer Inst.
Liston-Folb
Mine Safety Appliances
Perkin-Elmer Corp.
Reeder & Co., C. M.
Servo Corp.

### DETECTORS, Leak (See Gas Leak Indicators)

### DETECTORS, Lie

Associated Research
Electro-Medical Labs.
Stoelting Co., C. H.

### DETECTORS, Mercury Vapor

Central Scientific
General Elec. Co.
Mine Safety Appliances

### DETECTORS, Metal

Aero Electronics
Allis-Chalmers
Associated Research
Detectron Co.
Du Mont Labs., Inc.
Fisher Research Lab.
General Elec. Co.
Geophysical Inst. Co.
Goldak Co.
Illinois Testing Labs.
McFarlin Co.
Menlo Research Lab.
Radio Frequency Labs.
RCA Div.
Streeter-Amet Co.
Wilmotte, Inc.

### DETECTORS, Methane

Baird Associates
Bristol Co.
Bullard Co., E. D.
Davis Emergency Equip.
Heiland Research
Johnson-Williams
Mine Safety Appliances

### DETECTORS, Microwave

Amer. Electroneering
Sperry Gyroscope Co.
Sperry Products
Sylvania Electric Prod.

### DETECTORS, Mine Gases

Davis Emergency Equip.
Heiland Research
Mine Safety Appliances

### DETECTORS, Neutron

General Electric
Georator Corp.
Kelley-Koett Inst. Div.
Nuclear Development Lab.
Nuclear Research & Dev.
Nucleonic Corp.
Radiation Counter Labs.
R-C Scientific Inst.
Wood Counterlab

### DETECTORS, Oxygen, Deficiency

Beckman, Inc., Arnold O.
Davis Emergency Equip.
General Elec. Co.
Mine Safety Appliances

**DETECTORS, Pin Hole**
Hillyer Inst.
Vacuum Electronic Engr.

**DETECTORS, Potential**
Feiler Engineering
General Elec. Co.
Geophysical Inst. Co.
Littelfuse Labs.
Minerallac Electric Co.
Sensitive Research Inst.
Varo Mfg. Co.
Westinghouse Elec.

**DETECTORS, Radioactivity**
Atomic Instrument
Beckman, Inc., Arnold O.
Berkeley Scientific
Canadian Radium
Cyclotron Specialities
Distillation Products, Inc.
General Elec. Co.
General Radio Co.
Geophysical Instrument
Goldak Co.
Herbach & Rademan
Kelley-Koett Inst. Div.
Menlo Research Lab.
Nuclear Instrument
Nuclear Research & Dev.
Radiation Counter Labs.
R-C Scientific Inst.
Scott, Inc., Hermon
Southwestern Ind. Elec.
Sylvania Elec. Prod.
Technical Associates
Tracerlab, Inc.
Victoreen Inst. Co.
Wood Counterlab.

**DETECTORS, Radiation (Dosimeters)**
Beckman, Inc., Arnold O.
Clarkstan Corp.
Cole Instrument
Consolidated Engr.
Georator Corp.
Kelley-Koett Inst. Div.
Menlo Research Lab.
Nucleonic Corp.
Process & Instruments
Radiation Counter Labs.
R-C Scientific
Technical Associates
Tracerlab
Western Radiation Lab.

**DETECTORS, Radium**
American Inst. Co.
Beckman Instruments
Berkeley Scientific
Canadian Radium
Detectron Co.
El-Tronics, Inc.
Fisher Research Lab.
Flett Lab.
Geophysical Inst. Co.
General Electric Co.
Goldak Co.
Kelly-Koett
Menlo Research Lab.
Morgan Instrument
Nuclear Dev. Lab.
Nuclear Inst. & Chem.
Radiation Counter Labs.
R-C Scientific Inst.
Rowe Engineering
Scott, Inc., Hermon
Stratex Instrument Co.
Technical Associates
Tracerlab, Inc.
Wood Counterlab.

**DETECTORS, Vibration (See Vibroscopes)**

**DETECTORS, Voltage**
Feiler Engineering
Freed Transformer
General Elec. Co.
Gen. Physical Laboratory
Ideal Commutator Dresser
Industrial Control
Meter Devices Co.
Rockwell Engr. Co.
S & C Electric
Sherron Metallic
Westinghouse Elec.

**DEW POINT INSTRUMENTS**
American Instrument
General Electric
Illinois Testing Labs.
Powers Regulator
Refinery Supply Co.
Surface Combustion
Welch Scientific

**DIAL INDICATORS, Dimensional**
American Meas. Insts.
Ames Co., B. C.
Brown & Sharpe
Chicago Dial Ind. Co.
Deming Indicator
DoALL Co.
Federal Prod. Corp.
Ferner Co.
General Elec. Co.
Gen. Engg. & Model Wks.
Micro Master Co.
Scherr Co., Inc.
Scientific Inst. Co.
Sheffield Corp.
Size Control Co.
Stafford Co.
Standard Gauge
Standard Products Inc.
Starrett Co.
Testing Machines, Inc.
U. S. Radium Corp.

**DIAL LIGHTS (See Pilot Lights)**

**DIAL MICROMETERS (See Micrometers, Dial)**

**DIALS & POINTERS**
Johnson, E. R.
Precision Tube Co.
Superior Tube

**DIFFERENTIAL PRESSURE (See Controllers, Gages, etc., Pressure)**

**DIFFRACTION GRATING (See Grating, Diffraction)**

**DILATOMETERS**
American Inst. Co.
Bristol Co.
Canadian Radium
Dietert Co.
Ferner Co.
Gaertner Scientific Corp.
Instrument Dev. Labs.
Leitz, Inc., E.
Maveg Mach. Sales
Rockwell Co., Stanley P.
Sylvania Elec. Labs.
Zeiss, Inc., Carl

**DIVIDERS, Voltage (Decade)**
Cole Instrument
Daven Co.
Electronic Dev. Lab.
Feiler Engineering
General Radio
Gray Instrument
Shallcross Mfg.
Thwing-Albert Inst. Co.
Walkirt Co.
Ward Leonard Elec. Co.

**DIVIDERS, Voltage (Radio Frequency)**
Beck Bros.
Clarke Inst. Corp.
Daven Company
Electronic Associates
Feiler Engineering
Ferris Inst. Co.
General Elec. Co.
General Radio Co.
Instrument Resistors, Inc.
International Resistance
Kay Electric
Mallory & Co.
Measurements Corp.
Ohmite Mfg. Co.
Potter Instrument
RCA Manufacturing
Sensitive Research Inst.
Shallcross Mfg. Co.
Sherron Metallic
Televiso Co.
Ward Leonard Elec. Co.

**DIVIDING HEAD, OPTICAL**
American Meas. Insts.
Engis Equipment
Ferner Co.
Gaertner Scientific
Griswold Mfg. Co.
Hillyer Instrument
Jarrell-Ash Co.
Vinco Corp.
Webber Gage Co.
Zeiss, Inc., Carl

**DIVIDING MACHINES**
Brown & Sharpe
Engis Equipment
Ferner Co.
Gaertner Scientific Corp.
Hayes Scientific Apps.
Hillyer Inst.
Martin-Hubbard Corp.
Micro Instrument Co.
Precise Instrument Co.

**DRAFT Indicators (See Gages, Draft) Recorders (See Gages, Draft)**

**DRAFT Controllers (See Controllers, Automatic Draft)**

**DRAWING INSTRUMENTS**
Alina Corp.
Alpha Instrument Co.
Alteneder & Sons
Brown & Sharpe
Bruning Co., Inc.
Brush Development
Charvoz-Roos Corp.
Dietzgen Co.
Drafto Co.
Gurley, W. & L. E.
Henschel & Co.
Hopp Press
**Instrumaster Industries**
Ithaca Sci. Inst. Co.
Keuffel & Esser Co.
Lovins Engr.
Micro Master Co.
Millers Falls Co.
Nelson Section Liner
Noris Instruments
Post Co., Frederick
Precise Measurements Co.
Rapidesign Inc.
Reed Research
Speidel & Co.
Starrett Co., L. S.
Stratex Instrument Co.
Suverkrop Instruments
United States Blue Print
Universal Drafting Mach.
V. & E. Mfg. Co.
Warren-Knight Co.
Weber Co., F.
White Co., Inc., David
Williams, Brown & Earle

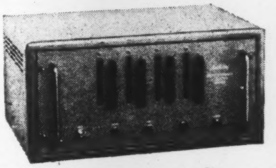
**DRIFT INDICATORS**
Driftmeters, Inc.
Eastman Oil Well
Eclipse-Pioneer Div.
Gurley, W. & L. E.
Kollmorgen Optical Co.

# ELECTRONIC INSTRUMENTATION

## *for* LABORATORY *or* PRODUCTION LINE!

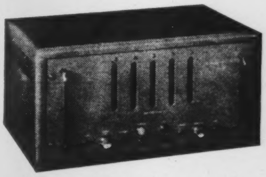
**DECIMAL COUNTING UNIT, MODEL 700** is a direct reading electronic counter capable of operating at speeds up to 30,000 counts per second. Digits from 0 to 9 are presented on illuminated front panel. Electrical reset to zero. Plug-in octal mounting for easy interchangeability. The counter operates on input pulse of 100 volt neg. with 2 microsec. max. rise time. Output will drive following unit in cascade. Dimensions 1⅜"x5"x5¼". Wt. 12 oz. Other models to a million counts per second.

**ELECTRONIC COUNTER, MODEL 10** was developed to meet the need for a rugged industrial counter operating at speeds up to 6000 counts per minute. Total count is displayed on the Decimal Counting Unit and the mechanical register to a maximum capacity of 9,999,999. Unit may be operated from closing contacts, photocell, or any means that will supply a positive potential of at least 3 volts. All circuitry moisture and fungus proofed. Unit is available in a variety of vapor-proof and explosion-proof housings to meet individual requirements. Dimensions 6¼" x 7¼" x 6½". Weight approximately 6 lbs.



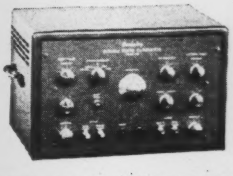
**PRESET COUNTER** consists of a series of scale-of-10 electronic counting units each in parallel with a 10-position push-button switch. This instrument accepts counts in the conventional manner at rates up to 10,000 cps. Any number from 0 to maximum capacity may be preset merely by depressing appropriate push-button in each column. Upon reaching the preset count, the unit supplies an output pulse to drive a register, close a gate, divert a production line or perform any other desired function. It then resets to 0 and recycles automatically. Available in any desired capacity.

**EVENTS PER UNIT TIME METER, MODEL 554** will automatically count and display the number of events that occur during a precise one second interval at rates up to 100,000 events per second. Accuracy is ± one event. Will operate either manually or automatically to count any mechanical, electrical, or optical occurrences, regularly or randomly spaced, that can be converted into changing voltages. Instrument counts for one second and displays the results on illuminated five-digit panel. Will recycle continuously on automatic operation. Convenient test switch permits 2 second self-check of entire unit. Dimensions 20¾" x 10½" x 15". Weight approximately 68 lbs.



**TIME INTERVAL METER, MODEL 510** provides a direct reading of elapsed time between any two events in the range of 0.000010 to 1.00000 seconds. Accuracy is ± 10 microseconds. Any occurrences that can be translated into changing voltages may be so timed. Timing may be started and stopped by independent voltages, the polarity of which may be selected by means of toggle switches. Sensitivity control permits selection of the amplitude of start or stop voltages at optimum level for elimination of interference. Dimensions 20¾" x 10½" x 15". Weight approximately 58 lbs.

**SINGLE/DOUBLE PULSE GENERATOR MODEL 903** is a general purpose laboratory instrument that supplies either single or paired pulses individually variable in amplitude, width and polarity. Pulse spacing is continuously variable from 0 to 10 microseconds, pulse width from 0.10 to 1.6 microseconds and pulse amplitude from 200 volts maximum negative and 50 volts maximum positive for 1000 ohm load, and 10 volts maximum negative and 50 volts maximum positive for 50 ohm load. Single or double pulses are available through separate panel connectors. Repetition rate internally controlled 1 to 1000 cps. Push-button control single cycle. External signal control for any rate up to 1000 cps.



*These are basic descriptions of representative standard instruments. A variety of modifications, both standard and special, are available to meet specific requirements. For complete details write Dep't. II.*

**Berkeley Scientific Corporation**

2200 WRIGHT AVE. • RICHMOND, CALIF.

A NATIONAL ORGANIZATION

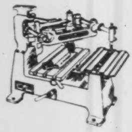
ENGRAVING MACHINES by PREIS

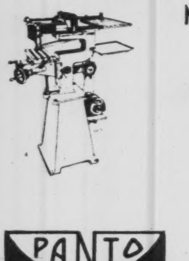
Preferred for Fast—Easy Engraving, Etching and Electric Marking of Lettering, Design, Calibrating and Numbering on Parts and Instruments of any Metal, Plastic or Other Material

Write for data

PANTO

H. P. PREIS ENGRAVING MACHINE CO.
661 State H'way 29, Hillside, N. J.





Kollsman Inst. Co.
Pioneer Instrument Co.
RCA Manufacturing
Servo Corp. of America
Thwing-Albert Inst. Co.

**DRIFT INDICATORS, Bore Hole**
Geophysical Inst. Co.
Sperry-Sun Well Surveying

**DRYERS, Instrument Air (See Air Dryers)**

**DUROMETERS (See Testers & Testing Machines, Hardness)**

**DUST ANALYSIS APPARATUS**
Baldwin-Lima-Hamilton
Central Scientific Co.
Corning Glass Works
Falstrom Co.
Federal Pneumatic Systems
Fisher Scientific Co.
Mine Safety Appliances
Pfaltz & Bauer, Inc.
Sargent & Co.
Scientific Glass Apparatus
Scientific Inst. Co.
Wilson Products, Inc.
Zeiss, Inc., Carl

**DYNAMOMETERS, Hydraulic**
Baldwin-Lima-Hamilton
Dynamatic Corp.
Emery Co., A. H.
Link Engineering
Monsell, J. R.
Olsen Testing Machine
Taylor Dynamometer

**DYNAMOMETERS, Pull Rod**
**Baldwin-Lima-Hamilton**
Conoflow Corp.
Dillon & Co.
Hathaway Inst. Co.
Hayes Scientific Apps.
Schaevitz Engg.
Seederer-Kohlbusch, Inc.
Statham Labs.
Stoelting Co., C. H.

**DYNAMOMETERS, Rotary Absortion**
Bristol Co.
Cole Instrument
Dynamatic Corp.
General Elec. Co.
L. A. B. Corp.
Link Engineering
Mid-West Dynamometer
Nankervis Co., G. L.
Taylor Dynamometer & Mach.

**DYNAMOMETERS, Tension**
Baldwin-Lima-Hamilton
Boulin Instrument Corp.
Chatillon & Sons
Coleman Inst. & Mfg.
Dillon & Co.
Emery Co., A. H.
Hathaway Inst. Co.
Olsen Testing Machine
Riehle Div.
Schaevitz Engg.
Seederer-Kohlbusch
Statham Labs.
Stoelting Co., C. H.
Thwing-Albert
Wiancko Engineering

**DYNAMOMETERS, Transmission**
Baldwin-Lima-Hamilton
Hathaway Instrument
Kellogg Switchboard
Link Engineering
Nankervis Co., G. L.
Rubicon Co.
Seederer-Kohlbusch

**EARTH CURRENT METERS (See Meters, Earth Current)**

**EARTH RESISTANCE METERS**
American Inst. Co.
Associated Research
Automatic Elec. Sales
Berkeley Scientific
Biddle Co., Jas. G.
Borden Engineering
Geophysical Inst. Co.
Gray Instrument
Heiland Research
Industrial Insts., Inc.
Miller, M.C.
Rawson Electrical Inst.
Rubicon Co.
Shallcross Mfg.
Sticht & Co.

**EBULLIOMETERS**
American Inst. Co.
Bellco Glass Inc.
Braun Corp.
Central Scientific Co.
Distillation Products, Inc.
Ferguson Co.
Fisher-Scientific
Kontes Glass Co.
Podbielniak, Inc.
Precision Scientific
Precision Therm.
Rascher & Betzold
Refinery Supply Co.
Tagliabue Div.

**EBULLISCOPE (See Ebulliometers)**

**ECHELON GRATING (See Grating, Echelon)**

**ELECTRIC WAVE FILTER SECTIONS**
Aerovox Corp.
Bailey Electric Co.
Berkshire Laboratories
Clarke Inst. Corp.
Clough-Brengle Co.
Electronic Dev. Lab.
Freed Transformer
General Radio Co.
Millen Mfg. Co.
Sherron Metallic
Southwestern Ind. Elec.
Standard Transformer
Thordarson Elec. Mfg.

**ELECTROANALYSIS APPARATUS**
Aero Electronics
Burrell Tech. Sup.
Central Scientific
Coleman Electric
Eberbach & Son
Fisher Scientific
La Motte Chem. **Prod.**
Leitz, Inc.
**Precision Scientific**
**Schaar & Co.**
Servo Corp. of America
Sherron Metallic

**ELECTROLYSIS INSTRUMENTS**
Bristol Co.
Rawson Elec. Insts.
Welch Scientific
Weston Elec. Inst.

**ELECTROMETERS, Quadrant**
**Cambridge Inst. Co.**
Dittmore & Freimuth
Nuclear Inst. & Chem.
Pfaltz & Bauer, Inc.
Rawson Elec. Inst.
Rubicon Co.
Testrite Instrument Co.
Welch Mfg. Co.

**ELECTROMETERS, String**
Cambridge Inst. Co.
Dearborn Scientific
Dittmore & Freimuth
Geophysical Inst. Co.
Nuclear Inst. & Chem.
Pfaltz & Bauer, Inc.
Victoreen Instrument Co.

**ELECTROMETERS, Vibrating Reed**
Aero Instrument
Applied Physics Corp.
Furst Electronics
Loudon Insts.

**ELECTRONIC EQUIPMENT SUPPLIERS**
Sun Radio & Electronics
Walker-Jamieson

**ELECTROPLATING SOLUTION TESTING APPARATUS**
Central Scientific Co.
Federal Telegraph Co.
Fisher Scientific Co.
Hellige, Inc.
Industrial Insts., Inc.
National Tech. Labs.
Patwin Inst. Div.
Pfaltz & Bauer, Inc.
Sargent & Co.
Sherron Metallic
Taylor & Co., W. A.
Thwing-Albert Inst. Co.

**ELECTROSCOPES**
Canadian Radium
Central Scientific Co.
Chicago Apparatus Co.
Denver Fire Clay Co.
Geophysical Inst. Co.
Henson Co., Fred C.
Kelly-Koelt
Nuclear Inst. & Chem.
Pfaltz & Bauer, Inc.

**ELLIPSOGRAPHS (SEE Drawing Instruments)**

**END MEASURES**
Acme Industrial
Engis Equipment
Ferner Co.
Lufkin Rule
Pratt & Whitney
Sheffield Corp.

**ENGINE INDICATORS See Indicators, Engine)**

**ENGINE INDICATOR REDUCING MOTION (See Reducing Motion, Engine Indicator)**

**ENGRAVING EQUIPMENT**
Acromark Co.
Allied Engrav. & Stamping
DoALL Co.
Preis Engraving, H. P.
Stafford Co.

**EUDIOMETERS**
Ace Glass Inc.
Central Scientific Co.
Machlett & Son

**EUSCOPES**
Bausch & Lomb Optical
Stocker & Yale

**EXPANSION TEST APPARATUS (See Testers, Expansion)**

**EXTENSOMETERS**
American Inst. Co.
Baldwin Locomotive
**Brabender Corp.**
Cambridge Inst. Co.
Eitzen Co.
Federal Products Corp.
Ferner Co.
Gaertner Scientific

(Continued)

Gen. Engg. & Model Wks.
Hayes Scientific Apps.
Metzger & Son
Olsen Testing Machine
Rutishauser Corp.
Schaevitz Engineering
Statham Labs.
Swedish Gage

**EYEGLASSES, POLARIZED (for Photoelastic Work or Strain Observation, etc.)**
Polarizing Inst. Co.
Zeiss, Inc., Carl

**FAULT LOCATORS, Communication Lines**
Aero Electronics
Audio-tone Oscillator
Automatic Elec. Chicago
Borden Engineering
Century Geophysical
Dillon & Co.
General Electric
Industrial Insts., Inc.
Leeds & Northrup
Rawson Elec. Inst. Co.
Raytron, Inc.
Rubicon Co.
Shallcross Mfg. Co.
Tobe Deutschmann Corp.
Westinghouse Elec.

**FEED WATER METERS**
Bailey Motor Co.
Bristol Co.
Brown Inst. Div.
Builders-Providence
Central Station Steam
Elec. Indicator Co.
Fischer & Porter
Foxboro Co.
Hagan Corp.
Henszey Co.
Leeds & Northrup
Mason-Neilan Regulator
Republic Flow Meters
Simplex Valve & Meter
Sparling, R. W.

**FEED WATER TESTING APPARATUS**
Allis-Chalmers
Burrell Technical Supply
Central Scientific Co.
Hagan Corp.
Hellige, Inc.
Industrial Insts., Inc.
LaMotte Chemical Prod.
Leeds & Northrup Co.
**Palo-Myers**
Pfaltz & Bauer, Inc.
Photovolt Corp.
Taylor & Co., W. A.

**FEEDERS, Automatic, Proportioning**
Automatic Temp. Control
Bowser Inc.
Builders-Providence
Fischer & Porter
General Controls
Gump Co., B. F.
Henszey Co.
Lapp Insulator
Merrick Scale
Milton Roy Pumps
Omega Machine
Permutit Co.
Proportioneers, Inc.
Schaffer Paidometer Co.
Wallace & Tiernan

**FEEDERS, Automatic Granular Material**
Builders-Providence
Federal Classifier
Gump Co., B. F.
Merrick Scale
Omega Machine
Permutit Co.
Proportioneers, Inc.
Schaffer Paidometer Co.

**FIELD-STRENGTH MEASURING SETS**
Clarke Ints. Corp.
Empire Devices, Inc.
Federal Telephone
Ferris Inst. Corp.
General Elec. Co.
Marion Inst.
McFarlin Co.
Measurements Corp.
Panoramic Radio Co.
RCA Div.
Sherron Metallic
Tobe Deutschmann Corp.

**FILLING MACHINES, Automatic**
All Amer. Tool & Mfg.
Allis-Chalmers
Anderson Bros. Mfg. Co.
Automatic Scale
Baltimore Biological Lab.
Bowser Inc.
Gump Co., B. F.
National Inst.
Potter Instrument
Proportioneers, Inc.
Richardson Scale Co.
Stokes & Smith Co.
Triangle Package Mach.

**FILTERS, Instrument Air**
Anders Co.
Dollinger
Hankison Corp.
Pittsburgh Lectrodryer
Pritchard & Co.

**FILTERS, Electrical Wave**
Berkshire Laboratories
Cinema Engr.
Cole Instrument
General Radio
Gertsch Products
Gulton Mfg. Co.
Hycar Co.

(Continued)

Kay Electric Co.
Marconi Inst. Ltd.
Pacific Div.
Tobe Deutschman
Vectron, Inc.

**FILTERS, Light (See also Filters, Optical)**
American Inst. Co.
Baird Associates
Bausch & Lomb Opt.
Bell & Howell
Bolsey Corp.
Central Scientific Co.
Corning Glass Works
Crystal Research Labs.
Dearborn Scientific
Fish-Schurman Co.
Goerz Amer. Optical Co.
Kollmorgen Optical Co.
Leitz, Inc.
Palos Optical Co.
Perkin-Elmer Corp.
Precise Measurements Co.
Zeiss, Inc., Carl

**FILTERS, Optical**
Baird Associates
Bausch & Lomb Optical
Binswanger & Co.
Boehmke Optical Co.
Bolsey Corp.
Crystal Research Labs.
Dearborn Scientific
Eastman Kodak Co.
Electro-Physics
E & S Optical
Ferner Co.
Fecker, J. W.
Fish-Schurman
General Scientific Corp.
Geophysical Inst. Co.
Goerz Amer. Optical Co.
Hayward Optical Glass
Henson Co., Fred C.
Ice Optical Co., H. C.
Jones Optical Works
Klett Mfg. Co.
Palos Optical Co.
Perkin-Elmer Corp.
Pfaltz & Bauer, Inc.
Phoenix Precision Inst.
Photovolt Corp.
Precise Measurements Co.
Pyrometer Inst. Co.
Republic Lens
Rubicon Co.
Simpson Optical Mfg.
Testrite Instrument Co.
Triumph Mfg. Co.
Unertl Optical Co.
Univis Lens Co.

**FINDERS, Valve Box**
Detectron
Geophysical Inst. Co.
Globe Phone Mfg.
Goldak Co.
Wilder, R. S.

**FIRE CONTROL INSTRUMENTS, MILITARY & NAVAL**
Aero Electronics
Arma Corporation
Bausch & Lomb
Bell & Howell Co.
Betts & Betts
Daca Machine & Tool
Elec. Indicator Co.
Electronic Associates
Fecker J. W.
Ford Instrument
General Elec. Co.
H-B Instrument
Instrument Dev. Lab.
**Kollmorgen Optical Co.**
Librascope
Martin-Hubbard Corp.
Maxson Corp.
Perkin Elmer Corp.
Robinette Co., W. C.
Sperry Gyroscope Co.
Unertl Opt. Co.
Vectron, Inc.
Wiancko Engineering

**FLASH POINT TESTERS (See Testers, Flash Point)**

**FLATNESS TESTERS (See Testers, Flatness, Light Wave)**

**FLATS, OPTICAL**
Acme Scientific
American Lens
American Optical
Am. Telescope Labs.
Baird Associates
Bausch & Lomb Optical
Binswanger & Co.
Bray Optical
Buechele, W.
Cal-Astro Optical Labs.
Central Scientific Co.
Clark & Sons
Crystal Research Labs.
Curtiss Labs.
Dearborn Scientific Co.
DoAll Co.
Dome Precision
Ednal Co.
Electro-Physics
Engis Equipment
E & S Optical
Fecker, Inc.
Ferner Co.
Fish-Schurman Co.
Fuess, Inc.
Gaertner Scientific Corp.
General Scientific Corp.
Geophysical Inst. Co.
Glendale Optical
Goerz Amer. Optical Co.
Hayward Scientific Glass
Henson Co., Fred C.
Herron Optical
Howland Optical Works
Ice Optical Co., H. C.

(Continued)

International Glass
Jarrell-Ash Co.
**Jones Optical Works**
Kollmorgen Optical Co.
Mann Co., Wm. I.
Master Optical Co.
Mico Instrument Co.
Miller Corp., William
Optron Laboratory
Pacific Optical
Palos Optical Co.
Penn Optical & Inst.
Perkin-Elmer Corp.
Phoenix Prec. Inst.
Plummer & Kershaw
Pratt & Whitney
Republic Lens
Ruska & Co.
Scherr Co., Inc., George
Sheffield Corp.
Schneider-Cogswell
Simpson Optical
Tinsley Laboratories
Unertl Optical Co.
Univis Lens Co.
Van Keuren Co.
Vinco Corp.
Wilder, R. S.
Zenith Optical Co.

**FLATS, OPTICAL, Fused Quartz**
Acme Scientific
American Lens
Bausch & Lomb Opt.
Cal-Astro Optical Labs.
Crystal Research Labs.
Dearborn Scientific
DoAll Co.
Dome Precision
Engis Equipment
E & S Optical
Fecker, Inc.
Fish-Schurman Corp.
Gaertner Scientific
Geophysical Inst. Co.
Henson Co., Fred C.
Howland Optical Co.
Ice Optical Co., H. C.
International Glass
Jarrell-Ash Co.
Jones Optical Works
Mann Co., W. I.
Optron Laboratory
Palos Optical Co.
Perkin-Elmer Corp.
Phoenix Prec. Inst.
Plummer & Kershaw
Scherr Co., Inc.
Sheffield Corp.
Simpson Optical Mfg.
Thermal Syndicate Ltd.
Tinsley Laboratories
Unertl Optical Co.
Van Keuren Co.

**FLIGHT DIRECTION INDICATORS**
Aero Electronics
Electro-Mec Lab.
Specialties, Inc.
Sperry Gyroscope Co.
Stafford Co.
Weston Elec. Inst.

**FLIGHT TEST INSTRUMENTS**
Aero Electronics
Applied Science Corp.
Electronic Associates
Federal Telegraph Co.
Gannon Co.
General Elec. Co.
Hathaway Instrument
Heiland Research
Impact Register
Lewis Engineering
M. B. Mfg. Co.
Revere Corp.
Sperry Gyroscope Co.
Statham Labs.
Televiso Products

## "FLOW"

**(Flowmeters measure primarily RATE of flow. For positive or "quantity" fluid meters, see the numerous classes under "Meters")**

**FLOWMETERS, AIR (See Flowmeters, Gas)**

**FLOWMETERS, AREA Cone & Disk Type**
Commercial Research
Fischer & Porter
**Friez Instruments**
Hays Corp.
National Meter Co.
Phoenix Precision Inst.

**FLOWMETERS, AREA Cylinder & Piston Type**
American Inst. Co.
Bowser Inc.
Fischer & Porter
Hays Corp.
National Meter Co.
New Jersey Meter Co.
Phoenix Precision Inst.

**FLOWMETERS, AREA, Free Float Type**
Brooks Rotameter
Commercial Research
Fischer & Porter
Fish-Schurman Corp.
Hammel-Dahl Co.
Hays Corp.
Hoke, Inc
Mercury Glass Co.
Penn. Ind. Inst. Corp.
Phoenix Prec. Inst.
Podbielniak, Inc.
Schutte & Koerting Co.

(Continued)

*Engrave*
. . . PANELS UP TO 25" WIDE
IN YOUR OWN SHOP WITH THE
*NEW* ENGRAVOGRAPH
Portable Model 1-S

TRACER GUIDED FOR UNSKILLED LABOR

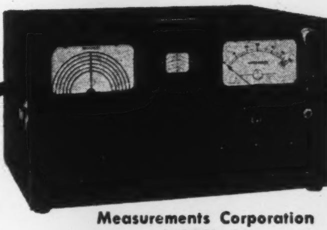
**Send for Booklets**
**I-S 37-portable model**
**H 37-heavy duty model**

The *only* portable machine which reproduces 15 sizes from one master alphabet.

The *only* one with *adjustable* copy holding slides for multiline engraving in one set-up.

Self-centering holding vise for nameplates.

**NEW HERMES, Inc.**
13-19 University Place New York 3, N. Y.
*World's largest manufacturer of portable engraving machines*



**Measurements Corporation**
**MODEL 58**

**UHF RADIO NOISE & FIELD STRENGTH METER**

*Frequency Range*
**15 Mc. to 150 Mc.**

**FREQUENCY ACCURACY:** ±2%. Individually calibrated dial.

**SENSITIVITY RANGE:** 1 to 100,000 microvolts. Direct reading dial.

**POWER SUPPLY:** Built-in supply, 117 volts AC, 6 volts DC.

**MEASUREMENTS CORPORATION**
BOONTON NEW JERSEY

ENGRAVING
ROUTING
PROFILING
MODELING

**GREEN ENGRAVER**
*Proved Profitable —*
*Machine Tool, Radio, Electrical and Instrument Mfrs., Sales Promotion and Advertising.*

Fast, rugged, convenient—and **inexpensive.** The Green Engraver is tops for low-cost performance—zips out **precision** work on metal, plastics or wood . . . cuts four lines of letters from 3/64" to 1" on curved or flat surfaces . . . operates by tracing . . . makes **anyone** an expert . . . engraves panels, name plates, scales, dials, molds, lenses and instruments. (Also widely used for routing, profiling, and three dimensional modeling.) Electric etching attachment available.

**Special attachments and engineering service available for production work.**

FREE—Fact-packed folder. Send for yours, today.

**GREEN INSTRUMENT CO.**
GREEN
383-B Putnam Avenue
Cambridge, Mass.

**FLOWMETERS, AREA Orifice & Plug Type**
American Meter Co.
Bacharach Industrial Inst.
Bailey Meter Co.
Bristol Co.
Fischer & Porter
Hays Corp.
Henszey Co.
Mason-Neilan Regulator
Meriam Inst. Co.
Minneapolis-Honeywell
Republic Flow Meters
**Robinson Orifice**
Simplex Valve & Meter
Taylor Inst. Cos.
Trimount Instrument

**FLOWMETERS, BLAST (See Flowmeters, Gas)**

**FLOWMETERS, ELECTROMAGNETIC**
Mittleman Electronics

**FLOWMETERS, GAS**
Ace Glass, Inc.
American Inst. Co.
American Meas. Insts.
American Meter Co.
Automatic Temp. Cont.
Bacharach Industrial Inst.
Bailey Meter Co.
Barton Inst. Co.
Bowser Inc.
Bristol Co.
Brooks Rotameter
Builders-Providence
Clark Blast Meter
Commercial Research
Cook Electric
Corning Glass Works
Eclipse-Pioneer Div.
Electric Heat Control
Elec. Indicator Corp.
Engelhard, Charles
Engr. Research & Dev.
Fischer & Porter
Fish-Schurman Co.
Foster Engg.
Foxboro Co.
**Fries Instrument**
Gas Appliance Specialties
General Elec. Co.
Giannini & Co.
Hagan Corp.
Hastings Inst. Co.
Hays Corp.
Henszey Co.
Hoke, Inc.
Illinois Testing Labs.
International Filter Co.
King Engg. Corp.
Kollsman Inst. Co.
Laboratory Equip. Corp.
Leeds & Northrup
Leupold & Stevens

(Continued)

Linde Air Products
Mason-Neilan Regulator
Meriam Co.
Minneapolis-Honeywell
Mittelman Electronics
Moore Products
National Inst. Labs.
National Meter Co.
New Jersey Meter Co.
Northwest Instrument
Penn Ind. Inst. Corp.
Phoenix Prec. Inst.
Pitometer Log Corp.
Podbielniak, Inc.
Precision Scientific
Refinery Supply Co.
Republic Flow Meters
Revere Corp.
Schutte & Koerting Co.
Scientific Glass Apparatus
Sheffield Corp.
Simplex Valve & Meter
Statham Labs.
Superior Meter Co.
Tagliabue Div.
Taylor Inst. Cos.
Trimount Instrument
U. S. Gauge
Victory Engr.

**FLOWMETERS, LIQUID (See Flowmeters, Gas)**

**FLOWMETERS, Open-Stream**
Bailey Meter Co.
Bristol Co.
Builders-Providence
Foxboro Co.
G. M. Mfg. Co.
Hagan Corp.
Hays Corp.
Leupold & Stevens
Mason-Neilan Regulator
Penn Ind. Inst. Corp.
Republic Flow Meters
Scientific Inst. Co. Calif.
Simplex Valve & Meter
Victory Engr.
Westberg Mfg. Co.
White Co.

**FLOWMETERS, Orifice, and Nozzle**
Ace Glass, Inc.
American Meter Co.
Askania Regulator Co.
Bacharach Industrial Inst.
Bailey Meter Co.
Barton Inst. Co.
Bristol Co.
Builders-Providence
Campbell Co., J. A.
Commercial Iron Works
Corning Glass Works
Daniel Orifice Fitting
Fischer & Porter
Foxboro Co.

(Continued)

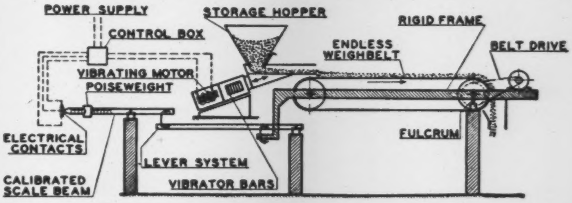
Hagan Corp.
Hays Corp.
Hoke, Inc.
Leeds & Northrup Co.
Leupold & Stevens
Mason-Neilan Regulator
Meriam Instrument
Minneapolis-Honeywell
Moore Products
National Inst. Labs.
Penn Ind. Inst. Corp.
Permutit Co.
**Refinery Supply Co.**
Republic Flow Meters
Robinson Orifice
Schutte & Koerting
Scientific Glass Apparatus
Scientific Inst. Co.
Simplex Valve & Meter
Tagliabue Div.
Taylor Inst. Cos.
Trimount Instrument

**FLOWMETERS, Pitot Tube**
Am. Blower Corp.
American Meter Co.
Askania Regulator Co.
Bacharach Industrial Inst.
Bailey Meter Co.
Barton Inst. Co.
Bristol Co.
Cambridge Inst. Co.
Central Scientific Co.
Clark Blast Meter
Defender Automatic Reg.
Dwyer Mfg. Co.
Eclipse-Pioneer Div.
Ellison Draft Gage Co.
Foxboro Co.
**Fries Instrument**
Hagan Corp.
Hays Corp.
Illinois Testing Labs.
Kollsman Inst. Co.
Leupold & Stevens
Meriam Instrument
Morey & Jones, Ltd.
Pitometer Log Corp.
Precision Therm. & Inst.
Precision Tube Co.
Refinery Supply Co.
Republic Flow Meters
Revere Corp.
Simplex Valve & Meter
Taylor Inst. Cos.
Trimount Instrument

**FLOWMETERS, Steam**
American Meter Co.
Bailey Meter Co.
Barton Inst. Co.
Bristol Co.
Builders-Providence
Fischer & Porter
Foxboro Co.
Hagan Corp.

(Continued)

*WEIGH FEEDERS . . .*



The Jeffrey-Traylor WAYTROL is a high precision machine for accurate weighing, feeding, batching and proportioning. Vibrating feeder is weight-controlled. Rate of delivery automatically regulated through a weigh-belt mechanism. Accurate and flexible.

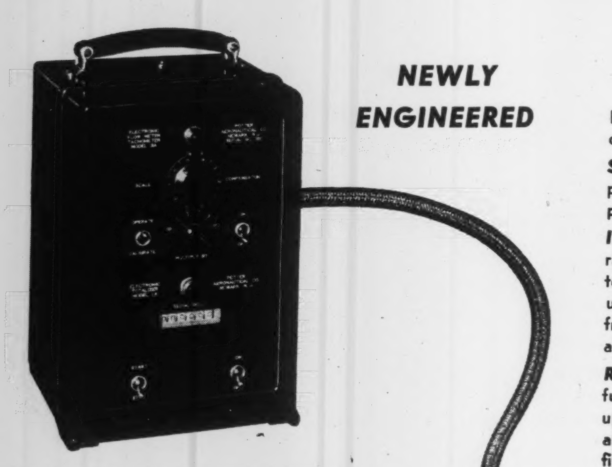
**BIN-LEVEL INDICATOR**

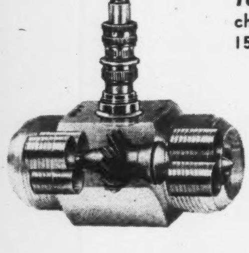
An instrument designed to show bin level at a glance. Can be used to control feed to bin, maintain a definite bin level, or control discharging equipment. Both units patented. Send for details.

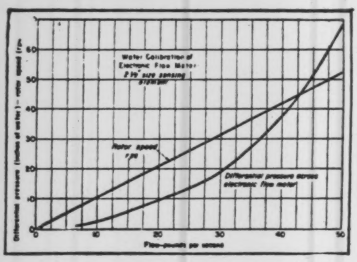
**The Jeffrey Manufacturing Company**
**795 North Fourth Street, Columbus 16, Ohio**

Baltimore 2
Beckley, W. Va.
Birmingham 3
Boston 16
Buffalo 2
Chicago 1
Cincinnati 2
Cleveland 15
Denver 2
Detroit 13
Forty Fort, Pa.
Harlan, Ky.
Houston 2
Jacksonville 2
Milwaukee 2
New York 7
Philadelphia 3
Pittsburgh 22
St. Louis 1
Salt Lake City 1

Jeffrey Mfg. Co. Ltd., Montreal, Canada
Jeffrey-Galion (Pty.) Ltd., Johannesburg, S. A.
The Ohio Malleable Iron Co., Columbus, Ohio
British Jeffrey-Diamond Ltd., Wakefield, England
The Galion Iron Works & Mfg. Co., Galion & Bucyrus, Ohio
The Kilbourne & Jacobs Mfg. Co., Columbus, Ohio
Galion (Great Britain) Ltd., Wakefield, England






Water Calibration of Electronic Flow Meter 2 ½" size sensing element
Rotor speed rps
Differential pressure across electronic flow meter
Differential pressure (inches of water) — rotor speed (rps)
0
10
20
30
40
50
60
Flow—pounds per second

POTTER *Electronic* FLOWMETER *and* TACHOMETER

NEWLY ENGINEERED

Eliminates Bearing Maintenance, Friction Drag, and High Pressure Drop

For difficult flow measuring problems involving high capacity, extremely corrosive liquids, gases, acids, and liquid oxygen.

***Sensing Element:*** Standard unit handles 3500 PSI. Unaffected by pressure or temperature. Bearingless spinning rotor in pick-up unit permits operation in fluids carrying gritty particles.

***Instrumentation:*** Either recording or visual indication with six scale ranges permitting accurate readability for all flow rates. Built-in temperature compensated electric tuning fork permits over-all accuracy using a recording potentiometer of better than ½%. Operates on frequency basis giving both rate of flow and total flow. Lightweight airborne units available for operation on either 24 volts or 400 cycles.

***Range:*** Exceptional range for any given size. Unit same diameter as fuel line and uses standard fittings. Available in sizes ranging from ¼" upwards with flow rates from .1 gallon per minute to 3000. Compact and easily installed. Units weigh little more than standard fuel line fittings.

***Tachometer:*** Simply by flicking a switch, the standard flowmeter is changed into a recording tachometer with a range of 300 rpm to 150,000 rpm.

***Send for Bulletin 1050***

POTTER AERONAUTICAL CO.
89 Academy Street, Newark 2, N. J., U.S.A.
***ENGINEERED AIRCRAFT ACCESSORIES***

Hays Corp.
Leeds & Northrup Co.
Mason-Neilan Regulator
Meriam Co.
Minneapolis-Honeywell
Moore Products
Penn Ind. Inst. Corp.
Republic Flow Meters
Simplex Valve & Meter
Tagliabue Div.
Taylor Inst. Cos.
Trimount Inst.

**FLOWMETERS, Vane**
Eclipse-Pioneer Div.
Friez Inst. Div.
Hays Corp.
Illinois Testing Labs.
Mason-Neilan Regulator
Simplex Valve & Meter

**FLOWMETERS, Venturi-Type**
American Meter Co.
Bailey Meter Co.
Barton Inst. Co.
Bristol Co.
Builders-Providence
Eclipse-Pioneer Div.
Foxboro Co.
Gauther, Donat A.
Hagan Corp.
Hays Corp.
International Filter Co.
Leeds & Northrup
Leupold & Stevens
Mason-Neilan Regulator
Minneapolis-Honeywell
Penn Ind. Inst. Corp.
Republic Flow Meters
Revere Corp.
Simplex Valve & Meter
Taylor Inst. Cos.
U. S. Gauge

**FLOWMETERS, Weir**
Bailey Meter Co.
Bristol Co.
Builders-Providence
Elec. Indicator Corp.
Fischer & Porter
Foxboro Co.
Gurley, W. & L. E.
Hagan Corp.
Hays Corp.
Leupold & Stevens
Mason-Neilan Regulator
Penn Ind. Inst. Corp.
Republic Flow Meters
Simplex Valve & Meter
Taylor Inst. Cos.

**FLUE GAS ANALYZERS**
**See Gas Analyzers, Flue Gas)**

**FLUID METERS, GAS**
**(See Gas Meters)**

**FLUID METERS, LIQUID**
**(See Meters, Liquid)**

**FLUID METERS, QUANTITY (See Gas Meters; Meters, Current; Meters, Liquid)**

**FLUORESCENT MERCURY VAPOR TUBES EMITTING WHITE LIGHT (See Light Sources)**

**FLUROMETERS**
American Instrument
Coleman Electric
Farrand Optical
Menlo Research Lab.
Phoenix Precision Inst.

**FLUOROSCOPES**
General Elec. X-Ray Dept.
Kelley-Koett
Menlo Research Lab.
North American Phillips
Patterson Screen Div.
Picker X-Ray Corp.
Universal X-Ray Prods.
Westinghouse X-Ray Co.

**FLUXMETERS**
Annis Co.
Associated Research
Cambridge Inst. Co.
Central Scientific Co.
Clarke Inst. Corp.
Clarkstan Corp.
Fraser Dev. Lab.
General Elec. Co.
Leeds & Northrup Co.
Marion Electrical Inst.
Rawson Electrical Inst.
Rubicon Co.
Sensitive Research Inst.
Sticht Co.
Varian Associates

**FOLDING ENDURANCE TESTERS (PAPER)**
**(See Testers, Folding Endurance)**

**FOOT CANDLE METERS**
Central Scientific Co.
De-Jur Amsco Corp.
General Elec. Co.
G-M Labs.
Hickok Elec. Inst.
Marion Elec. Inst.
MB Mfg. Co.
Pfaltz & Bauer, Inc.
Photovolt Corp.
Rockwell Engr.
Triplett Elec. Inst.
Welch Scientific
Weston Elec. Inst. Corp.

**FORCE MEASURING EQUIPMENT**
Aero Electronics
Askania Regulator
Century Geophysical
Chatillon & Sons
Dillon & Co., W. C.
Engineering Res. & Dev.
Gulton Mfg. Co.
Industrial Electronics
Statham Labs.
Stewart Inst.
Wiancko Engineering

**FOREWARN DETECTOR, for locating hidden weapons (See Detectors, Metal)**

**FORKS, Synchronization**
American Time Prods.
Elec. Tachometer Corp.
Gaertner Scientific Corp.
Leeds & Northrup
MacLeod & Hanopol
Philamon Labs.
Riverbank Laboratories
Times Facsimile Corp.

**FORKS, Tuning**
American Time Prods.
Bunnell Co., J. H.
Clay-Adams Co.
Gaertner Scientific
General Electric Co.
Goetze Niemer Co.
Hathaway Instrument
Heiland Research
Philamon Labs.
Riverbank Labs.
Stoelting Co., C. H.
Times Facsimile Corp.

**FORKS, Tuning, Electrically Driven**
American Inst. Co.
American Time Prods.
Bunnell Co., J. H.
Cambridge Inst. Co.
Central Scientific Co.
Century Geophysical
Chicago Apparatus Co.
Electronic Prod. Co.
Elec. Tachometer Corp.
Engineering Labs., Inc.
Gaertner Scientific Corp.
General Electric Co.
General Radio Co.
Hathaway Inst. Co.
Leeds & Northrup
Metron Instrument
Philamon Labs.
Riverbank Laboratories
Sherron Metallic
Stoelting Co., C. H.
Times Facsimile Corp.
Varo Mfg. Co.
Welch Mfg. Co.

**FORKS, Vacuum Driven**
Cambridge Inst. Co.
Gaertner Scientific Corp.
General Radio
Philamon Labs.
Riverbank Laboratories
Times Facsimile Corp.

**FRACTIONAL HORSEPOWER MOTORS (See Motors, Fractional Horsepower)**

**FRACTIONATING COLUMNS, Laboratory Glass**
Glass Engr. Labs.
Kontes Glass Co.
Phoenix Precision Insts.
Podbielniak, Inc.
Uhrig Co., Joseph F.

**FREENESS TESTERS**
**(See Testers, Freeness)**

**FREQUENCY METERS, Controlling**
Feiler Engineering
General Elec. Co.
Kellogg Switchboard
Leeds & Northrup Co.
Minnesota Electronics

**FREQUENCY METERS, Electronic**
Berkeley Scientific
Berkshire Labs.
Browning Labs.
Clarke Inst. Corp.
Cole Instrument
Conn, Ltd., C. G.
Daven Co.
De-Jur-Amsco Corp.
Electronic Dev. Lab.
El-Tronics, Inc.
Engineering Res. & Dev.
Federal Telephone
Feiler Engineering
Furst Electronics
General Elec. Co.
General Radio Co.
Gertsch Products
Harvey Radio Labs.
Hastings Inst. Co.
Hewlett Packard Co.
Knights Co.
Lampkin Lab.
Lavoie Laboratories
M B Mfg. Co.
Metron Instrument
Millen Mfg. Co.
Potter Instrument
RCA Div.
Rowe Radio Research
Sherron Metallic
Sylvan Electronic Labs.
Walkirt Co.

**FREQUENCY METERS, Indicating**
Berkeley Scientific
Biddle Co., James B.
Burlington Inst. Co.
Electro-Tech. Equip.
Electronic Engineers
General Elec. Co.
General Radio Co.
Hagedorn Engineering
Hastings Inst. Corp.
Hathaway Instrument
Hickok Elec. Inst. Co.
J-B-T Instruments
Kellogg Switchboard
Leeds & Northrup Co.
Metron Instrument
Minnesota Electronics
Potter Instrument
RCA Div.
Roller-Smith
Sensitive Research Inst.
Sperry Gyroscope Co.
Standard Elec. Time
Thordarson Elec. Mfg.
Triplett Elec. Inst.
Varo Mfg. Co.
Walkirt Co.
Westberg Mfg. Co.
West Coast Electronics
Westinghouse Elec.
Weston Elec. Inst. Corp.

**FREQUENCY METERS, Microwave**
Amer. Electroneering
Berkeley Scientific
Browning Laboratories
Electro-Tech Equip. Co.
General Electric Co.
Kay Electric
Mico Instrument
Sperry Gyroscope Co.
Sylvania Elec. Prod.

**FREQUENCY METERS, Recording**
Bristol Co.
Cole Instrument
Engineering Res. & Dev.
Esterline-Angus Co.
General Elec. Co.
Leeds & Northrup Co.
Metron Instrument
Minnesota Electronics
Potter Instrument
Roller-Smith Co.
Sheffield Corp.
Sound Apparatus
Telechron, Inc.
West Coast Electronics
Westinghouse Elec.

**FREQUENCY METERS, Standards**
American Time Prods.
Bliley Electric Co.
(Continued)

Browning Labs.
Crystal Research Labs.
Doolittle Radio
Electronic Dev. Lab.
Feiler Engineering
Ferris Inst. Corp.
General Electric Co.
General Radio Co.
Hathaway Instrument
Hewlett-Packard
Jacobs Instruments
Knights Co.
Lavoie Laboratories
Millen Mfg. Co.
Potter Instrument
Radioactive Products

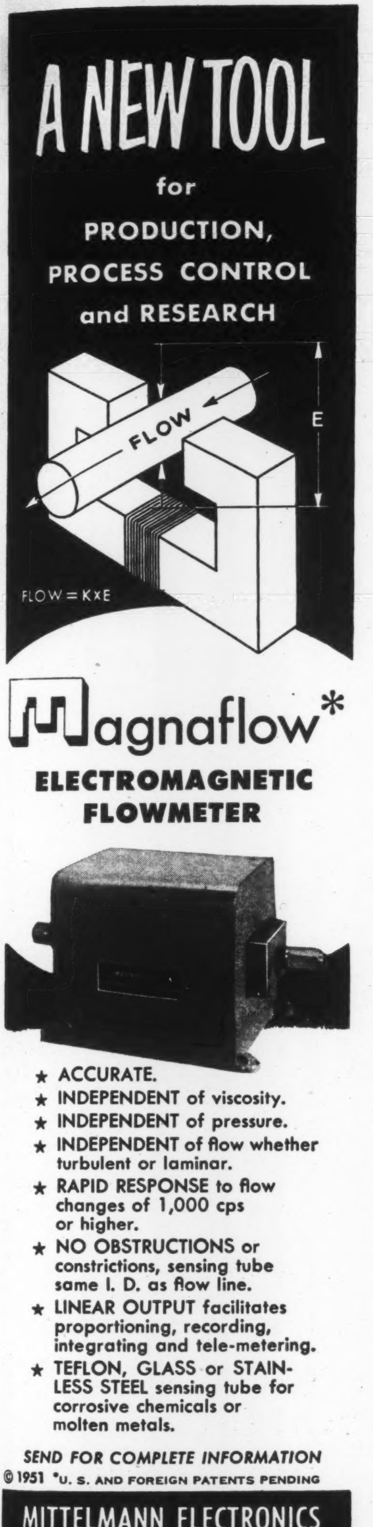
**FREQUENCY METERS Vibrating Reed**
Aero Instrument Co.
Biddle Co., Jas. G.
Cole Instrument
Furst Electronics
Hagerdorn Engineering
J-B-T Insts., Inc.
Triplett Elec. Inst.

**FREQUENCY MONITORS**
Alden Products
Browning Laboratories
General Electric Co.
General Radio Co.
Hewlett-Packard
Kay Electric
Knights Co., James
Lampkin Laboratories
Potter Instrument
RCA Div.
Sylvania Elec. Prod.
Walkirt Co.

**FREQUENCY RESPONSE RECORDERS, Automatic**
Audio-Tone Oscillator
General Elec. Co.
Martin-Hubbard Corp.
Sound Apparatus Co.

**FRITTED GLASS FILTERS & APPARATUS**
Central Scientific Co.
Corning Glass Works
Electronic Products
Fischer & Porter
Microchemical Service
Mine Safety App. Co.
Pfaltz & Bauer, Inc.
Phoenix Prec. Inst.
Scientific Glass App.

**FUEL ANALYSIS APPARATUS**
American Inst. Co.
Burrell Tech. Supply Co.
Central Scientific Co.
Eitzen Co.
Fisher Scientific Co.
(Continued)



A NEW TOOL
for
PRODUCTION,
PROCESS CONTROL
and RESEARCH

Magnaflow*
ELECTROMAGNETIC
FLOWMETER

- ★ ACCURATE.
- ★ INDEPENDENT of viscosity.
- ★ INDEPENDENT of pressure.
- ★ INDEPENDENT of flow whether turbulent or laminar.
- ★ RAPID RESPONSE to flow changes of 1,000 cps or higher.
- ★ NO OBSTRUCTIONS or constrictions, sensing tube same I. D. as flow line.
- ★ LINEAR OUTPUT facilitates proportioning, recording, integrating and tele-metering.
- ★ TEFLON, GLASS or STAINLESS STEEL sensing tube for corrosive chemicals or molten metals.

SEND FOR COMPLETE INFORMATION
© 1951 *U. S. AND FOREIGN PATENTS PENDING

MITTELMANN ELECTRONICS
DIVISION
CENTURY AMERICA CORPORATION
549 West Washington Blvd.
Chicago 6, Illinois STate 2-8021

Hays Corp.
Machlett & Son
Parr Instrument Co.
Podbielniak, Inc.
Precision Scientific Co.
Proportioneers, Inc.
Sargent & Co.
Tagliabue Div.

**FUEL FLOW INDICATORS**
Askania Regulator Co.
Autocall Co.
Bailey Meter Co.
Barton Inst. Co.
Bristol Co.
Brooks Rotameter
Brown Inst. Div.
Commercial Research
Eclipse-Pioneer Div.
Engineering Res. & Dev.
Fischer & Porter
Foxboro Co.
General Elec. Co.
Hastings Inst. Co.
Hays Corp.
Mason-Neilan Regulator
National Airoil Burner
Revere Corp.
Schutte & Koerting
Statham Labs.
Tagliabue Div.
Taylor Inst. Cos.

**FURNACE CONTROL SYSTEMS** (See Controllers, Automatic)

**FURNACES, LABORATORY, HIGH TEMPERATURE**
American Instrument Co.
Burrell Tech. Supply
Central Scientific
Dietert Co.
Distillation Products
Electric Hotpack Co.
Ferner Co.
Fisher Scientific Co.
Gordon Co., Claud S.
Hevi Duty Electric
Huppert Co.
Laboratory Equipment
Lindberg Engineering Co
Machlett & Son
Marshall Co., L. H.
Modern Electrical Lab.
Precision Scientific
R-S Prod. Corp.
Selas Co.
Shallcross Controls
Surface Combustion
Tenney Engineering
Thermo Elec. Mfg. Co.
Thomas Co., Arthrur H.

**FURNITURE, LABORATORY**
Alfab Manufacturing
Browne-Morse Co.
Burrell Technical Supply
Fisher Scientific Co.
Hamilton Mfg. Co.
Kewaunee Mfg. Co.
Laboratory Const. Co.
Laboratory Equipment
Laboratory Furniture Co.
Metalab Equipment
Moline Furniture Works
Sheldon & Co.
Sjostrom Co.
Southern Desk Co.
Welch Scientific

**FUSES, INSTRUMENT**
**Kellogg Switchboard**
Littelfuse, Inc.
Meter Devices Co.

**GAGE BLOCKS**
Barr Instrument
Dearborn Gage Co.
Dearborn Scientific
DoAll Co.
Fonda Gage
Ford Motor Co.
Illinois Tool Works
Jansson Gage Co.
Lincoln Park Tool
Pratt & Whitney
Precision Scientific
Scherr Co., George
Size Control Co.
Standard Gage Co.
Swedish Gage
Van Keuren Co.
Webber Gage Co.

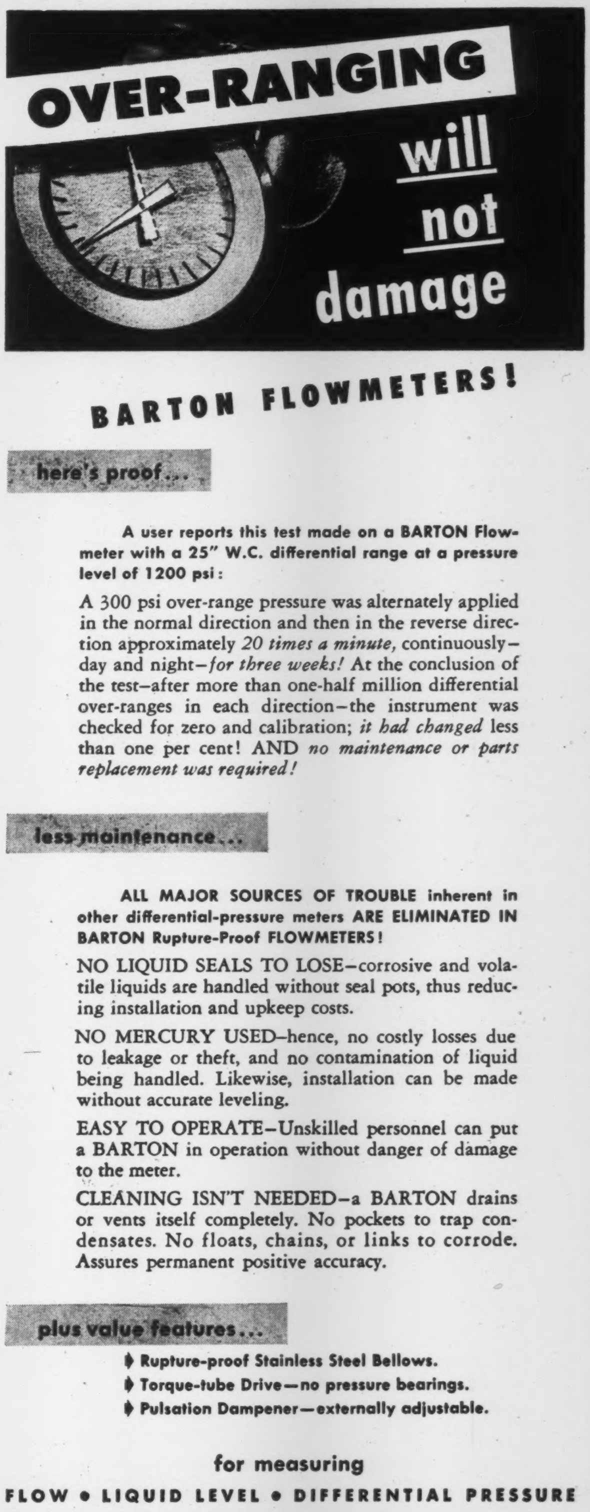
**GAGE BLOCKS, Angle**
Palos Optical Co.
Size Control Co.
Webber Gage Co.

**GAGE BLOCKS, Surface Finish**
Surface Checking Gage

**GAGE COCKS**
Manning, Maxwell & Moore
Marsh Corp.
U. S. Gauge
Weatherhead

**GAGE GLASS ILLUMINATORS**
Jerguson Gage & Valve
National Co.

**GAGE TESTERS, Deadweight**
American Inst. Co.
Amthor Testing Inst. Co.
Coleman Inst. & Mfg.
Crosby Steam Gage Co.
Darley Co., W. S.
Gordon Co., Claud S.
Grove Regulator
Manning, Maxwell & Moore
Mansfield & Green
Olsen Testing Machine
Precision Scientific
Refinery Supply Co.
Ruska Inst. Corp.
Trerice Co.



OVER-RANGING will not damage

BARTON FLOWMETERS!

here's proof...

A user reports this test made on a BARTON Flowmeter with a 25" W.C. differential range at a pressure level of 1200 psi:

A 300 psi over-range pressure was alternately applied in the normal direction and then in the reverse direction approximately *20 times a minute,* continuously—day and night—*for three weeks!* At the conclusion of the test—after more than one-half million differential over-ranges in each direction—the instrument was checked for zero and calibration; *it had changed* less than one per cent! AND *no maintenance or parts replacement was required!*

less maintenance...

ALL MAJOR SOURCES OF TROUBLE inherent in other differential-pressure meters ARE ELIMINATED IN BARTON Rupture-Proof FLOWMETERS!

NO LIQUID SEALS TO LOSE—corrosive and volatile liquids are handled without seal pots, thus reducing installation and upkeep costs.

NO MERCURY USED—hence, no costly losses due to leakage or theft, and no contamination of liquid being handled. Likewise, installation can be made without accurate leveling.

EASY TO OPERATE—Unskilled personnel can put a BARTON in operation without danger of damage to the meter.

CLEANING ISN'T NEEDED—a BARTON drains or vents itself completely. No pockets to trap condensates. No floats, chains, or links to corrode. Assures permanent positive accuracy.

plus value features...

- Rupture-proof Stainless Steel Bellows.
- Torque-tube Drive—no pressure bearings.
- Pulsation Dampener—externally adjustable.

for measuring
FLOW • LIQUID LEVEL • DIFFERENTIAL PRESSURE
WRITE FOR DETAILS IN BULLETIN 11C4 TODAY!

BARTON
INSTRUMENT CORPORATION
1431 SO. EASTERN AVE., LOS ANGELES 22, CALIF.

*You Get Even, No Glare*
LOW COST LIGHTING
*for Gages, Rotameters, etc.*
*with*

JERGUSON
Explosion-Proof
GAGE
ILLUMINATORS

*Single and Double Section Jerguson Illuminators on a 3-Section Gage.*

UNDERWRITERS' LABORATORIES APPROVED

YOU get even, no glare, Low Cost Lighting with Jerguson Gage Illuminators . . . the improved illuminators that are unexcelled for gages, rotameters, etc. They give you ideal illumination with safety . . . and make possible faster, easier, accurate reading.

Jerguson Illuminators use the principle of solid wedge lighting to give you *clear, even lighting, without bright spots.* Light flows through the plastic wedge and is reflected evenly. A single small bulb gives you better illumination at a cost so low that savings quickly pay for the illuminator.

Jerguson Illuminators are approved by Underwriters' Laboratories and are built in accordance with their Standard for Electric Lighting Fixtures for use in hazardous locations for Class 1, Group D Services. Made in a variety of sizes; also available in a non-explosion proof model.

*Investigate Today. Write for Data Unit on Jerguson Illuminators*

JERGUSON
*Gages and Valves for the Observation of Liquids and Levels*
JERGUSON GAGE & VALVE COMPANY
100 Fellsway, Somerville 45, Mass.
Representatives in Major Cities
Phone Listed Under JERGUSON
Jerguson Tress Gage & Valve Co. Ltd., London, Eng.

**GAGE TESTERS, Fluid scale**
Crosby Steam Gage Co.
Manning, Maxwell & Moore
Refinery Supply

**GAGE TESTERS, Liquid-column**
Ideal Lab. Tool
Manning, Maxwell & Moore
Meriam Inst. Co.
Miller Falls Co.
Parks Co., Harry S.
Pioneer Instrument
Refinery Supply
Trerice Co.

**GAGES (See also Object of Measuring and Control)**

**GAGES, Absolute Pressure**
Bailey Meter Co.
Bristol Co.
Cook Electric
Distillation Products
Eclipse-Pioneer Div.
Emery Co., A. H.
Flader Inc., Frederic
Foxboro Co.
Fredericks Co., Geo.
General Elec. Co.
Giannini & Co.
Hathaway Inst. Co.
Hays Corp.
Kollsman Inst. Div.
Manning, Maxwell & Moore
Marsh Corp.
Mason-Neilan Regulator
Meriam Inst. Co.
Minneapolis-Honeywell
Moeller Instrument
Moore Products
Precision Thermometer
Scientific Inst. Co.
Servomechanisms, Inc.
Skaneateles Mfg. Co.
Statham Labs.
Tagliabue Div.
Taylor Inst. Cos.
Trans-Sonics, Inc.
Trimount Inst. Co.
Uehling Instrument Co.
United States Gauge
Wallace & Tiernan
Wiancko Engineering

**GAGES, Adjustable Length**
Acme Industrial
Barr Instrument
DoAll Co.
Federal Products Corp.
Merz Enginering
Nilsson Gage Co.
Saart, Kraemer & Hanscom
Scherr Co., George
Sheffield Corp.
Size Control Co.
Standard Gage
Swedish Gage
Woodworth Co.

**GAGES, Air**
American Chain & Cable
American Meter Co.
Bailey Meter Co.
Bastian-Blessing Co.
Beacon Gage
Block Mfg. Co.
Bristol Co.
Dwyer Mfg. Co.
Eclipse-Pioneer Div.
Electric Auto-Lite
Federal Products
Fischer & Porter
Foxboro Co.
Friez Div.
Fulton Sylphon Div.
Hastings Instrument
Hays Corp.
Lambert Meter Co., Inc.
Manning, Maxwell & Moore
Marsh Corp.
Marshalltown Mfg.
Mason-Neilan Regulator
Meriam Inst. Co.
Merz Enginering
Moore Products
Parks Co., Harry S.
Pratt & Whitney
Rochester Mfg. Co.
Seely Inst. Co.
Sheffield Corp.
Statham Labs.
Tagliabue Div.
Taylor Inst. Cos.
Trerice Co
Uehling Inst. Co.
U. S. Gauge
Weksler Thermometer
Witt Gage Co.

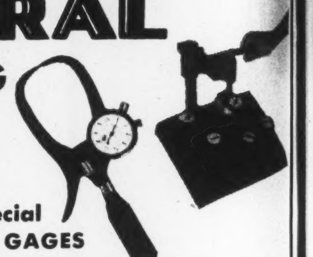
**GAGES, Air-gap**
Federal Products

**GAGES, Alarm**
Acragage Co.
Bailey Meter Co.
Barton Inst. Co.
Bristol Co.
Brown Inst. Div.
Ellison Draft Gage Co.
Fischer & Porter
Foxboro Co.
Magnetrol, Inc.
Manning, Maxwell & Moore
Marsh Corp.
Marshalltown Mfg.
Mason-Neilan Regulator
Parks Co., Harry S.
Petrometer Corp.
Precision Therm. & Inst.
Rochester Mfg. Co.
Trerice Co.
U. S. Gauge
Weksler Thermometer
Wheelco Instruments

**GAGES, Amplifying**
Ames Co., B. C.
Comtor Corp.

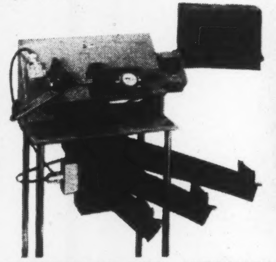
(Continued)

FEDERAL
INDICATING GAGES



Regular and Special
DIAL INDICATOR GAGES
All types for controlling dimensions: snap, hole, thickness, grinding, caliper, comparator, depth and many others.

Dimensional Air Gages
Simplest to install and operate, foolproof and extremely accurate. Adaptable.



ELECTRONIC AND AUTOMATIC SORTING GAGES — made to suit requirements.

*Send for Catalog —*
FEDERAL PRODUCTS CORPORATION
1105 EDDY STREET • PROVIDENCE 1, R. I.

Engineering Res. & Dev.
Federal Prod. Corp.
Merz Engineering
Poole Instruments
Pratt & Whitney
Precision Gage & Tool
Scherr Co., Inc.
Sheffield Corp.
Statham Labs.
Swedish Gage

**GAGES, Automatic Sorting**
Arma Corporation
DoAll Co.
Electric Eye Equip.
Federal Products Corp.
Hathaway Instrument
Heyman Co.
Magnetic Gauge Co.
Martin-Hubbard Corp.
Merz Engineering
Pratt & Whitney
Rockwell Engr.
Rowe Engineering
Sheffield Corp.

**GAGES, Bore**
Brown & Sharpe
Commercial Research
Comtor Co.
Federal Prod. Corp.
Industrial Prod. Div.
Lufkin Rule Co.
Merz Engineering
Moore Products
Nilsson Gage Co.
Poole Instruments
Pratt & Whitney
Scherr Co.
Sheffield Corp.
Size Control Co.
Standard Gage
Swedish Gage
Vinco Corp.

**GAGES, Bourdon**
Acragage Co.
American Chain & Cable
Automatic Temp. Control
Bailey Meter Co.
Baldwin Locomotive
Bastian-Blessing Co.
Beacon Gage Co.
Bristol Co.
Builders-Providence
Crosby Steam Gage
Dickson Co.
Electric Auto-Lite
Emery Co., A. H.
Esterline-Angus
Foxboro Co.
Giannini & Co., G. M.
Gordon Co., Claud S.
Gotham Inst. Co.
Hays Corp.
Heise Bourdon Tube

(Continued)

Hoke, Inc.
Kollsman Inst. Co.
Lonergan Co.
Manning, Maxwell & Moore
Marsh Corp.
Marshalltown Mfg.
Mason-Neilan Regulator
Mercoid Corp.
Minneapolis-Honeywell
Perfex Corp.
Republic Flow Meters
Shallcross Controls
Sheffield Corp.
Taylor Inst. Cos.
Trerice Co.
United States Gauge
Weksler Thermometer
Welch Scientific
Wheelco Instruments
Witt Gage Co.

**GAGES, Caliper (Dial)**
Amer. Measuring Insts.
Ames Co., B. C.
Brown & Sharpe
Comtor Co.
DoAll Co.
Federal Prod. Corp.
Glogau & Co.
Marshall Co.
Nilsson Gage Co.
Sheffield Corp.
Size Control Co.
Starrett Co.
Waltham Dial Gage

**GAGES, Center**
Brown Sharpe
Bryant Chucking
Lufkin Rule Co.
Miller Falls Co.
Sheffield Corp.
Size Control Co.
Starrett Co.

**GAGES, Coating Thickness**
American Inst. Co.
Ames Co., B. C.
Branson Instruments
Gardner Laboratory
General Electric Co.
Industrial Nucleonics
Koehler Instrument

**GAGES, Comparator**
Amer. Measuring Insts.
Ames Co., B. C.
Menter Scope Inst.
Compar Inst. Co.
Comtor Co.
DoAll Co.
Eitzen Co.
Engineers Specialty Div.
Federal Prod. Co.
Ferner Co.
General Elec. Co.
General Engg. & Model
Hathaway Instrument

(Continued)

Johnson Gage Co.
Jones & Lamson Machine
Link Engg. & Mfg.
Merz Engineering
Metron Instrument
Moore Products
Nilsson Gage Co.
Poole Instruments
Pratt & Whitney
Precision Gage & Tool
Saart, Kraemer & Hanscom
Scherr Co.
Sheffield Corp.
Size Control Co.
Standard Gage
Stocker & Yale
Surface Checking Gage
Swedish Gage
Waltham Dial Gage
Woodworth Co.

**GAGES, Compression**
Bacharach Indus. Inst.
Baldwin Locomotive
Dillon & Co.
Electric Auto-Lite
Marsh Corp.
Olsen Testing Machine
Pratt & Whitney
Precision Scientific
Riehle Div.
Statham Labs.
Toledo Scale Co.
United States Gauge
Wiancko Engineering
Witt Gage Co.

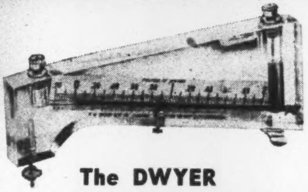
**GAGES, Concentricity**
Engis Equipment
Federal Products
Saart, Kraemer & Hanscom
Sheffield Corp.
Size Control Co.
Swedish Gage Co.

**GAGES, Continuous Thickness**
Aero Electronics
Commercial Research
DoAll Co.
Electric Eye Equip.
Fedral Prod. Corp.
Foxboro Co.
Hathaway Instrument
Industrial Nucleonics
Magnetic Gauge Co.
Merz Engineering
Poole Manufacturing
Pratt & Whitney
Schaevitz Engg.
Sheffield Corp.
Starrett Co.
Telviso Products
Tracerlab Inc.
Waltham Dial Gage

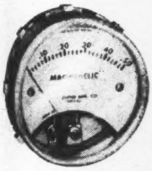
**GAGES, Continuous, Wid**
Aero Electronics
Barr Instrument

(Continued)

SENSITIVE —
DURABLE—
ACCURATE



The DWYER
TRANSPARENT INCLINED GAGE
for
distinct readings of pressure differentials up to 3" water—drafts —air velocities—filter resistances.



The DWYER
MAGNEHELIC
GAGE
for
dial type reading of highly sensitive pressure differentials. 0" to .5" of water and 0 to 2 psi. Helical magnetic linkage sensitive to .00025" movement of magnet. Lifetime wear.

F. W. Dwyer Mfg. Co.
333 South Western Avenue Chicago 12, Illinois

ACRAGAGE
Shockstop!
PAT. APPLIED FOR

Protects against Pulsation and Shock!

20
40
60
80
100
120
140
160
180
200
Acragage

Eliminates Snubbers – It Can't Plug –

The Most Significant Pressure Gage Development in 50 Years.

For the first time, a successful means of eliminating the effect of pulsation and shock on pressure gage mechanisms has been developed which DOES NOT introduce an orifice or restriction in the pressure connection.

It Can't Plug

FOR COMPLETE INFORMATION,
WRITE FOR CATALOG C-50

ACRAGAGE CO.
Formerly Clapp [illegible] Co.
MILFORD, CONN.

DoAll Co.
Engineering Res. & Dev.
Federal Products Corp.
General Electric
Hathaway Instrument
Merz Engineering
Pratt & Whitney
Sheffield Corp.

**GAGES, Contour see Gage, Profile**

**GAGES, Cylinder**
American Gage Co.
Ames Co., B. C.
Brown & Sharpe
Comtor Co.
Dearborn Gage Co.
Elgin National Watch
Federal Prod. Corp.
Lufkin Rule Co.
Merz Engineering
Nilsson Gage Co.
Poole Instruments
Pratt & Whitney
**Rimat Machine**
Sheffield Corp.
Size Control Div.
Standard Gage
Starrett Co.
Swedish Gage

**GAGES, Dead Weight**
American Instrument
Ames Co., B. C.
Beacon Gage
Coleman Inst. & Mfg.
Eastern Specialty
General Electric
Gordon Co., Claud S.
Grove Regulator
Link Engineering
Manning, Maxwell & Moore
Mansfield & Green
Marshalltown Mfg.
Parks Co., Harry S.
Ruska Inst. Corp.
Swedish Gage Co.

**GAGES, Depth, Linear**
Alina Corp.
Amer. Measuring Insts.
Ames Co., B. C.
Brown & Sharpe
Carson Micrometer
DoAll Co.
Federal Products Corp.
General Elec. Co.
Glogau & Co.
Jansson Gage Co.
Lincoln Park Tool & Gage
Lufkin Rule Co.
Merz Engineering
Millers Falls
Park Sales
Petrometer Corp.
Pratt & Whitney
R & M Mfg. Co.
Ryan Tool & Engg.
Saart, Kraemer & Hanscom
Shand & Jurs Co.
Sheffield Corp.
Size Control Co.
Standard Gage
Starrett Co.
Swedish Gage
Vapor Recovery System

**GAGES, Depth, Navigational**
Pacific Div.
Geophysical Inst. Co.
G. M. Mfg. Co.
King Engineering Corp.
Negus, T. S. & J. D.
Parks Co., Harry S.
U. S. Gauge

**GAGES, Dial, Machinists'**
Alina Corp.
American Meas. Insts.
Ames Co., B. C.
Brown & Sharpe
Chicago Dial Ind.
DoAll Co.
Eitzen Co.
Federal Prod. Corp.
Ferner Co.
Genales, Andrew
General Engg. & Model
Micro Master Co.
Nilsson Gage Co.
Sheffield Corp.
Size Control Co.
Standard Gage
Starrett Co.
Swedish Gage Co.

**GAGES, Differential Pressure**
Aeromarine Inst. Co.
American Meter Co.
Bacharach Industrial Inst.
Bailey Meter Co.
Barton Inst. Co.
**Beacon Gage Co.**
Pacific Div.
Bristol Co.
Builders-Providence
Cleveland Fuel Equip.
Crosby Steam Gage
Defender Automatic Reg.
Dwyer Mfg. Co.
Ellison Draft Gage Co.
Emery Co. A. H.
Engineering Res. & Dev.
Flader, Inc., Fredric
Foxboro Co.
**Friez Instrument**
Gas Appliance Specialties
Gauthier, Donat A.
General Elec. Co.
Hathaway Inst. Co.
Hays Corp.
Kollsman Inst. Div.
Leupold & Stevens
Manning, Maxwell & Moore
Marsh Corp.
Mason-Neilan Regulator
Meriam Instrument

(Continued)

In pumproom of leading plastics manufacturer, King-Gages keep a weight check on liquid chemicals in storage. Other King-Gages weigh these liquids into stills and mixing tanks.

The
King-Gage
Measures WEIGHT, VOLUME or DEPTH of Liquids in Storage or in Process

POUNDS
MILK

**WEIGHS** liquids in mixing and formulating—much faster than weigh tanks.

**MEASURES** acids, solvents, soap, tar, latex, milk, etc., where other methods are impractical, impossible or hazardous.

**WIDELY USED** in Food, Chemical, Marine, Beverage, Petroleum and many other industries—since 1928.

FEATURES

- Used with all types of tanks, vats and containers—open or closed.
- Can be located wherever desired—above or below tank, and at any distance up to many hundreds of feet.
- Reads directly in pounds or gallons.
- Permits accuracy of ¼% or better over long service life. No mechanical or electrical parts; works as a frictionless balance.
- Backed by complete engineering service.

SPECIFICATIONS

**SIZES:** Five standard sizes, with 12", 20", 28", 35" and 43" scales. Larger sizes available for special applications.

**SCALES:** Graduated in any desired units of depth, weight or volume, or in any *two* units where desired.

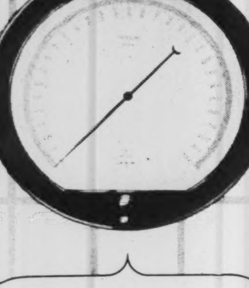
**LIQUID:** Mercury, for most depths over 12 ft.; No. 294 Red Liquid for most depths up to 12 ft.; or No. 120 Green Liquid, for depths to about 5 ft. where scale with widely-spaced graduations in small increments is wanted.

**FURNISHED** with built-in hand pump, or for connection to compressed air supply. Available with glass overflow check valve integral with glass tube.

**INSTALLED,** calibrated and serviced by the King Engineer in your territory.

*FOR FULL DETAILS, write for illustrated 12-page King-Gage bulletin —or tell us your liquid-measurement problem.*

KE INSTRUMENTS
KING ENGINEERING CORP.
Detroit Ave. Ann Arbor, Mich.
King-Gages—Manometers—Self-Closing Push Valves
Sight Feed Bubblers—Glass Tube Check Valves—Air Flow Snubbers—Sediment Traps—D. P. Transmitters



HEISE GAUGES

STANDARD OF THE WORLD

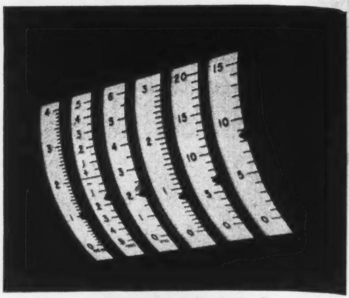
for measurements of pressure of extreme accuracy

- √ A design for every application
- √ Accurate to 0.2% of scale or better
- √ Minimum hysteresis and creep
- √ Revolving dial zero adjustment
- √ "In place" bleeding of air
- √ Special designs for use with mercury

For the unusual pressure gauge application — where extreme accuracy and stability under continuous-use or other exacting conditions are essential — Heise Gauges can be specified with confidence.

Manufactured on special order only in ranges from 0-15 to 0-10,000 psi. Sizes: 8½", 12" and 16". Prices: $151.60 to $211.20. Write for catalog.

**Heise Bourdon Tube Company, Inc.**
**Newtown, Connecticut**



REPUBLIC
DRAFT GAGES

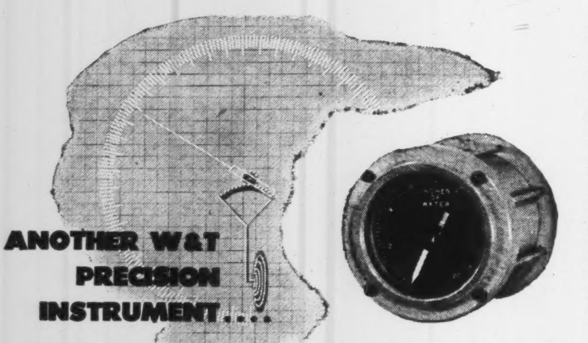
Republic multi-point indicators are supplied for all ranges of draft, pressure and differentials encountered in furnace operation in any desired combination.

Indicating units are interchangeable and are operated by a dry-bellows type of diaphragm. The 12-inch vertical, translucent scales are illuminated from the rear. All adjustments are made from the front of the panel and each unit may be withdrawn without disturbing others.

WRITE FOR DATA BOOK No. 802

**REPUBLIC FLOW METERS CO.**
2240 Diversey Pkwy. Chicago 47, Ill.

REPUBLIC
INSTRUMENTS • CONTROLS



*The W&T Precision Low Pressure Gauge*

The W&T Precision Low Pressure Gauge has proved to be the answer to the problem of measuring low pressure accurately by successful use in such fields as aircraft flight testing, automotive research work, and engine and ventilation studies. Built with custom care from its beryllium copper capsule to its individually calibrated dial, the W&T Low Pressure Gauge is a precision instrument of the highest grade.

Here are some of its outstanding features:
- Sensitive to 1 part in 500
- Available in ranges from 0 - 10" of water to 0 - 400" of water
- Measures differential pressure
- Unaffected by gravity or acceleration
- Equipped with expanded scale if desired

Write now and tell us your low pressure measuring requirements. We'll be glad to help — no obligation, of course.

A-78

WALLACE & TIERNAN
PRODUCTS, INC.
ELECTRICAL MECHANISMS AND PRECISION INSTRUMENTS
Belleville 9, New Jersey • Represented in Principal Cities

Metron Instrument
Minneapolis-Honeywell
Moeller Instrument
Moore Products Co.
National Inst. Labs.
Parks Co., Harry S.
Perfex Corp.
Phoenix Precision Inst.
Pioneer Instrument
Pitometer Log Corp.
Precision Scientific
Precision Therm.
Preferred Utilities Mfg.
Republic Flow Meters
Schaevitz Engg.
Scientific Glass Apparatus
Scientific Inst. Co.
Servomechanisms, Inc.
Sheffield Corp.
Simplex Valve & Meter
Statham Labs.
Tagliabue Div.
Taylor Inst. Cos.
Thermo Instruments
Trerice Co., H. O.
Trimount Instrument
Uehling Instrument Co.
U. S. Gauge
Victory Engr. Co.
Weksler Thermometer
Wiancko Engineering
Witt Gage Co.

**GAGES, Draft (See Gages, Differential Pressure)**

**GAGES, Drill Grinding**
Brown & Sharpe
Dearborn Gage Co.
Lufkin Rule Co.
Starrett Co.

**GAGES, Feeler**
Acme Industrial
American Meas. Insts.
Brown & Sharpe
Dearborn Gage Co.
Elgin National Watch
Engis Equipment
Lufkin Rule Co.
Millers Falls Co.
Size Control Co.
Starrett Co.
Swedish Gage
Van Keuren Co.
Vinco Corp.

**GAGES, Flush Pin**
Acme Industrial
Allen Gauge & Tool Co.
American Gage Co.
Amer. Measuring Insts.
Cadillac Gage Co.
Dearborn Gage Co.
Elgin National Watch
Federal Products Corp.
Fonda Gage Co.
Jansson Gage Co.
Lawrence & Hill
Lufkin Rule Co.
Merz Engineering
Nilsson Gage Co.
Saart, Kraemer & Hanscom
Sheffield Corp.
Sixe Control Co.
Swedish Gage
Vinco Corp.
Woodworth Co.
West & Dodge Thread

**GAGES, Gas**
American Meter Co.
Bailey Meter Co.
Bastian-Blessing
Bristol Co.
Connelly Co.
Dickson Co.
Foxboro Co.
Gas Appliance Specialities
General Elec. Co.
Hays Corp.
Linde Air Products
Manning, Maxwell & Moore
Mason-Neilan Regulator
Marsh Corp.
Meriam Instrument
Parks Co., Harry S.
Republic Flow Meters
Rochester Mfg. Co.
Specialty Glass Co.
Statham Labs.
Superior Meter Co.
Tagliabue Div.
Taylor Inst. Cos.
Uehling Instrument
Witt Gage Co.

**GAGES, Grinding**
Acme Industrial
American Meas. Insts.
Ames Co., B. C.
Brown & Sharpe
Comtor Co.
Dearborn Gage Co.
Elgin National Watch
Engineering Res. & Dev.
Federal Prod. Corp.
Lufkin Rule Co.
Master Gauge
Merz Engineering
Moore Products
Nilsson Gage Co.
Sheffield Corp.
Size Control Co.
Swedish Gage Co.

**GAGES, Grinding Finish**
General Electric Co.
Surface Checking Gage

**GAGES, Height**
Allen Gauge & Tool Co.
Amer. Measuring Insts.
Ashton Valve Co.
Barr Instrument
Brown & Sharpe
DoAll Co.
Federal Products Corp.
General Engg. & Model
Jansson Gage Co.
Leupold & Stevens
Lufkin Rule Co.
Merz Engineering
Park Sales Co.
Pratt & Whitney
Ryan Tool & Engg.
Scherr Co.
Sheffield Corp.
Size Control Co.
Standard Gage
Starrett Co.
Swedish Gage Co.
Vapor Recovery Systems

**GAGES, Hook**
Dwyer Mfg. Co.
Friez Instruments
Gurley, W. & L. E.
Leupold & Stevens
Lufkin Rule Co.
Scientific Inst. (Calif.)
Swedish Gage Co.
White Co., Inc.

**GAGES, Hydrostatic (See Gages, Liquid Level, Indicating)**

**GAGES, Internal Dial**
Ames Co., B. C.
Byrant Chucking Grinder
Comtor Co.
DoAll Co.
Federal Products Corp.
Gn. Engg. & Model Wks.
Merz Engineering
Nilsson Mfg. Co.
Scherr Co.
Sheffield Corp.
Size Control Co.
Standard Gage
Swedish Gage

**GAGES, Ionization**
General Electric
Nucleonic Corp.
Process & Instruments
Radiation Counter Labs.
Stoelting Co., C. H.
Tracerlab

**GAGES, Limit**
Acme Industrial
Amer. Measuring Insts.
Brown & Sharpe
Dearborn Gage Co.
Detroit Tap & Tool
Federal Products Corp.
Fonda Gage
General Elec. Co.
Greenfield Tap & Die
Jansson Gage Co.
Metron Instrument
Merz Engineering
Pratt & Whitney
Sheffield Corp.
Size Control Co.
Standard Gage

(Continued)

ACCO
Helicoid
Gage
U.S.A.

# Helicoid Gage Division

## AMERICAN CHAIN & CABLE COMPANY, INC.

BRIDGEPORT 2, CONNECTICUT

ACCO

REPRESENTATIVES IN ALL PRINCIPAL CITIES . . . SEE YOUR NEAREST DISTRIBUTOR

## ONLY HELICOID GAGES HAVE THE HELICOID MOVEMENT

0
30
60
90
120
150
180
210
240
270
300

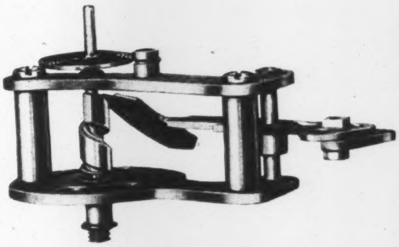
The new ACALOY case for Helicoid gages is a high compression molded aluminum alloy. Treated by patented process to prevent corrosion. Weatherproof. Greater strength — less weight. Durable baked-on finish. Neoprene gasket. Stainless steel (18-8) snap ring. Made with a back flange for surface mounting, and without a flange for stem mounting.

Rear view of ACALOY case shows safety blow-out discs supplied when specified. The discs are Bakelite, and are held by stainless steel snap rings. The safety discs release when the pressure in the case increases slightly. The glass front of the gage withstands approximately 35 p.s.i. in the 4½" dial size. Extra charge for safety blow-out discs.

0
10
20
30
40
50
60
70
80
90
100

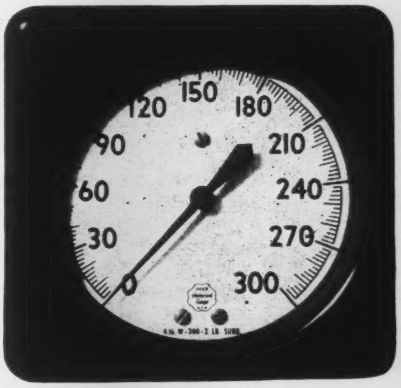
Weather-proof, molded Phenol Turret Case. Rugged, non-corroding, will not warp or crack, permanent, natural black finish. Stainless steel snap ring. Neoprene sealing gasket. Moisture-proof front. Supplied with bottom or back connection, for surface or stem mounting. Made in 4½", 6", and 8½" dial sizes.

**HELICOID CHEMICAL GAGE** for any pressure up to 2,500 p.s.i., for vacuum and compound gages; temperatures up to 300° F. Particularly for chemicals and other viscous liquids. Diaphragm made of TEFLON or KEL-F, depending on service, which resists practically all corrosive chemicals. Bottom part supplied of any metal most suitable for the service. Made in 4½", 6" or 8½" dial sizes. 1" female bottom connection.



### THE HELICOID MOVEMENT

In the Helicoid movement, motion is transmitted by a cam contacting the helical groove in a roller. Cam facing is polished, graphited Bakelite. Helical groove in roller is highly polished stainless steel. Hairline adjustment of pointer is made with screw driver from back of case. Link adjusting screw is at rear so that calibration is possible without removing dial or pointer. Connecting link and screws are K Monel.



**HELICOID SQUARE FLUSH CASE GAGE** for symmetrical panels saves space and improves appearance. Width of the square front flange is less than the diameter of the conventional round front flange. Available in 4½", 6" and 8½" dial sizes in all standard pressure ranges; with or without internal illumination, white or ultra violet light.

Aeromarine

LOW PRESSURE APPLICATIONS

LBS. PER SQ. INCH
2
3
5
10
8
6
5
4
3
2
AEROMARINE NEW YORK

**INDUSTRIAL:**

Pressure gauges:
Ranges from 0 - 10 inches of water
up to 0 - 30 P.S.I.

Vacuum gauges:
Ranges from 0 - 10 inches of water
up to Full vacuum

Differential Pressure Gauges:
Ranges: Same as Pressure gauges

Compound:
Both Pressure and Vacuum readings on dial (as illustrated)

These gauges are available with linear, expanded, or retarded dials.

**AIRCRAFT:**

Flight instruments, both civilian and Air Force.

**MARINE:**

Marine Speed Indicators

**AEROMARINE INSTRUMENT CO. INC.**
385 Gerard Ave.
New York 51, New York

Swedish Gage
Van Keuren Co.
West & Dodge
Woodworth Co.

**GAGES, Linear Measuring**

DoAll Co.
Federal Products
Gaertner Scientific
Gulton Mfg. Co.
Hillyer Inst.
Industrial Electronics
Saart, Kraemer & Hanscom
Sheffield Corp.
Starrett Co., L. S.
Statham Labs.
Swedish Gage Co.

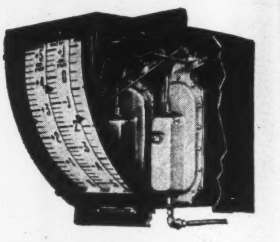
**GAGES, Liquid Level Indicating**

Acragage
American Meter Co.
Assoc. Valve & Engrg.
Autocall Co.
Automatic Control Co.
Automatic Temp. Control
Bacharach Industrial Inst.
Bailey Meter Co.
Barton Inst. Co.
Bastian-Blessing
Bin-Dicator Co.
Boston Auto Gage
Bowser & Co.
Bristol Co.
Builders-Providence
Bunnell Co., J. H.
B. W. Controller
Canadian Radium
Climax Div.
Control Corp.
Cook Electric
Crosby Steam Gage
Davis Reg. Co.
Defender Automatic Reg.
Dickson Co.
Dwyer Mfg. Co.
Eclipse-Pioneer Div.
Electric Auto-Lite
Elec. Indicator Corp.
Electric Tachometer Corp.
Elematic Equip. Co.
Electronic Prod. Co.
Engineering Research Ass.
Fischer & Porter
Fisher Governor Co.
Foxboro Co.
Frick Co.
Friez Instrument Div.
General Controls Co.
General Elec. Co.
Gorrell & Gorrell
Gotham Inst. Co.
Gray Instrument
Guardian Electric
Gurley, W. & L. E.
Hammel-Dahl Co.
Hathaway Inst. Co.
Hays Corp.
Instrument Lab., Inc.
Jerguson Gage Co.
Johnston & Jennings
Keckley Mfg. Co.
Kellogg Switchboard
King Engineering
Klingerit, Inc.
Leeds & Northrup Co.
Leupold & Stevens
Liquidepth Indicators
Liquidometer Co.
Lufkin Rule Co.
Lumenite Elec. Co.
Magnetrol, Inc.
Manning, Maxwell & Moore
Marsh Corp.
Marshalltown Mfg.
Mason-Neilan Regulator
McAlear Mfg.
McNeill Engineering
Meriam Instrument
Minneapolis-Honeywell
Moore Products
Natural Gas Equipment
Paragon Electric
Parks Co., Harry S.
Penberthy Injector Co.
Photoswitch, Inc.
Pitometer Log Corp.
Pneumercator Co., Inc.
Positel Mfg. Co.
Precision Therm.
Preferred Utilities Mfg.
Reliance Gauge Column
Republic Flow Meters
Revere Corp.
Rochester Mfg. Co.
Rosen Engg. Prods.
Schutte & Koerting Co.
Shand & Jurs Co.
Simmonds Aerocessories
Simplex Valve & Meter
Smith Corp., A. O.
Statham Labs.
Tagliabue Div.
Taylor Inst. Cos.
Thermo Instruments
Trerice Co.
Trimount Instrument
U C Indicator Sales
Uehling Instrument Co.
U. S. Gauge
Vapor Recovery Systems
Viking Instruments
Wallace & Tiernan
Weksler Thermometer
Warrick Co.
Westinghouse Elec. & Mfg.
Wheelco Inst. Co.
Wiancko Engineering
Williams Gauge Co.
Watt Gage Co.
Yarnall-Waing Co.

**GAGES, Liquid Level, Recording (See Gages, Liquid Level, Indicating)**

Bailey Meter Co.
Barton Inst. Co.
Bristol Co.

(Continued)



**BAILEY MULTI-POINTER GAGES**

● Bailey Multi-Pointer Gages are made with any number of pointers and any scale combination from one to twelve. The pointers have 10" motion over plainly marked plastic molded scales so that readings can be taken at a distance of 20 feet. Diaphragm actuated elements enable this gage to withstand over-drafts and overpressures without injury to the unit or its calibration.

All secondary factors such as draft, pressure, temperature, stoker speed and pulverizer feed can be indicated on one Bailey Multi-Pointer Gage.

**BAILEY METER COMPANY**
1041 IVANHOE ROAD · CLEVELAND, O
Bailey Meter Company Ltd., Montreal, Ca

Builders-Providence
Esterline-Angus
Foxboro Co.
Infilco, Inc.
International Filter Co.
Leupold & Stevens
Parks Co., Harry S.
Republic Flow Meters
Simplex Valve & Meter
Taylor Inst. Cos.
Uehling Inst. Co.

**GAGES, Mercury**

Amthor Testing Mach.
Bacharach Industrial Inst.
Bailey Meter Co.
Barton Inst. Co.
Builders-Providence
Central Scientific
Connelly Co.
Distillation Products
Dwyer Mfg. Co.
Electronic Products
Ellison Draft Gage
Gas Appliance Specialities
General Elec. Co.
Hays Corp.
Heise Bourdon Tube
Ideal Lab. Tool
King Engineering
Machlett & Son
Manning, Maxwell & Moore
Mason-Neilan Regulator
Meriam Instrument
Moeller Instrument
Parks Co., Harry S.
Precision Therm.
Refinery Supply Co.
Scientific Glass Apparatus
Scientific Instrument
Simplex Valve & Meter
Speciality Glass Co.
Stoetling Co., C. H.
Tagliabue Div.
Taylor Inst. Cos.
Trerice Co.
Trimount Instrument
Uehling Instrument Co.
U. S. Gauge Co.
Universal X-Ray Prods.
Wallace Scientific
Westinghouse Elec.

**GAGES, Micrometer**

American Meter Co.
Ames Co., B. C.
Amthor Testing Mach.
Axelson Mfg.
Bethlehem Apparatus Co.
Brown & Sharpe
Cadillac Gage Co.
Central Scientific Co.
Eitzen Co.
Electro Products Labs.
Elgin National Watch
Engis Equipment
Federal Products Corp.

(Continued)

Gaertner Scientific Corp.
Instrument Dev. Labs.
Lufkin Rule Co.
Miller Falls Co.
Pratt & Whitney
Precision Therm. & Inst.
Rimat Machine
Scherr Co.
Sheffield Corp.
Slocomb Co.
Starrett Co.
Stocker & Yale
Swedish Gage
Van Keuren Co.
Wilmotte, Inc.
Zeiss, Inc., Carl

**GAGES, Oil (See Gages, Liquid Level)**

**GAGES, Optical**

Acme Industrial
Amer. Measuring Insts.
Bausch & Lomb
Buchele, W.
Clark & Sons
DoAll Co.
Engineers Specialty Div.
Engis Equipment
Fecker, Inc.
Gaertner Scientific Corp.
Instrument Dev. Labs.
Jarrell-Ash Co.
Jones & Lamson Machine
Mann Co., W. I.
Palos Optical Co.
Perkin-Elmer Corp.
Phoenix Prec. Inst.
Ruska & Co.
Scherr Co.
Sheffield Corp.
Stocker & Yale
Zeiss, Inc., Carl

**GAGES, Paint Film**

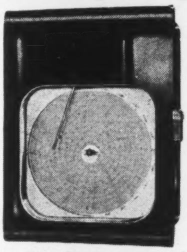
American Inst. Co.
Ames Co., B. C.
Branson Instruments
Gardner Laboratory
General Elec. Co.
Hathaway Inst. Co.
Metron Instrument
Munsell Color Co.

**GAGES, Paper Thickness (See Gages, Thickness)**

**GAGES, Piston Ring**

Amer. Measuring Insts.
Brown & Sharpe
Circle Gage Co.
Elgin National Watch
Federal Products Corp.
Link Engineering
Merz Engineering
Sheffield Corp.
Swedish Gage
Wilkening Mfg. Co.

## BRISTOL SERIES 500
## Recording and Controlling Gauges



Bristol Series 500 Gauges are offered in a wide variety of models for recording and controlling pressure, draft, vacuum, absolute pressure, liquid level.

These instruments are highly accurate, dependable, rugged and extremely stable in all ranges of application. They include many design improvements and refinements that make them easier to use, more convenient to service, readily convertible from one type to another and simpler in construction. In addition, the new case offers maximum protection for the working elements and a modern design in harmony with **the latest** industrial trends.

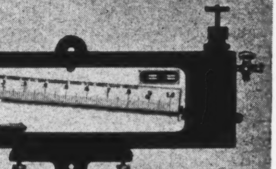
Wall and panel mounting; also portable. Ranges from full vacuum to 10,000 psi. Single, double or three-pen models.

Write for Bulletins G620, G621 and G622

**THE BRISTOL COMPANY**
113 BRISTOL RD., WATERBURY 20, CONN.

---

## DRAFT GAUGES



• **These are extremely serviceable direct reading instruments for measuring low pressures, drafts and differentials—built with inclined tubes to give increased scale length and permit the taking of readings in fractional inches of water. Each instrument individually calibrated to assure extremely accurate operation. Oil or mercury filled tubes. Also two-tube and three-tube models for taking multiple readings with the same gauge. Fully descriptive catalog sent on request.**

**THE MERIAM INSTRUMENT CO.**
10958 MADISON AVENUE
CLEVELAND 2, OHIO

**Manometers, Meters, and Gauges for the accurate measurement of Pressures, Vacuums and Flows of Liquids and Gases.**

---

## Now... NUMBER OF TANKS AND DISTANCE Unlimited
## ACCURATE *Remote* LIQUID LEVEL GAUGING

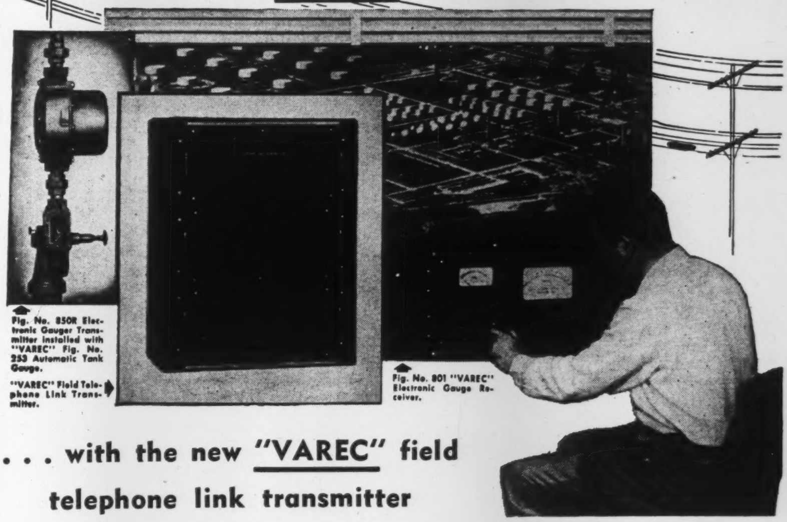


Fig. No. 850R Electronic Gauger Transmitter installed with "VAREC" Fig. No. 253 Automatic Tank Gauge.

"VAREC" Field Telephone Link Transmitter.

Fig. No. 801 "VAREC" Electronic Gauge Receiver.

### . . . with the new "VAREC" field telephone link transmitter

Now, with "Varec's" unique new Field Telephone Link Transmitter, (When used in conjunction with its Electronic Gauger Receiver and Electronic Gauger Transmitter) distance factors are literally unlimited, as are the number of tanks possible to gauge from a single remote point.

At the turn of a dial switch, accurate, REMOTE liquid level gauging in oil refineries, chemical plants, pipe line pump stations and storage terminals is an important reality.

Utilization of existing telephone or power lines minimize installation and wiring costs, in addition to material savings realized in time, labor and accurate gauging with a "Varec" Electronic Gauger installation.

Now it is possible for only one gauger or operator to obtain accurate (within $\frac{1}{8}$") continuous gauge readings from any one or a series of tanks simultaneously. The operator needs no special electronic knowledge to maintain or service the "Varec" unit as all parts are of standard plug-in design.

A complete extra service kit is included to assure continuous, dependable operation. WESTON Meter equipped. Low voltage, low current transmission only 0.001 volts D.C. at explosion-proof tank transmitter. Designed to operate from 110-115 volt, 50-60 cycle A.C. or 220 A.C. power at receiver.

There's a "Varec" Electronic REMOTE Liquid Level Gauging unit to meet your requirements. Where close control of blending operations is desired, automatic high and low valve, pump and alarm control is available. Adaptable for use with Brown Instruments, Foxboro Dynalog and Weston Instrument temperature and recording instruments for remote indications. Write for our recommendations on your gauging problems today.

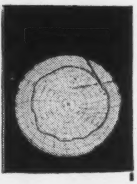
*FOR ALL TYPES OF TANKS — FOR SINGLE OR MULTIPLE INSTALLATIONS • 4 TYPES OF "VAREC" EXPLOSION-PROOF TRANSMITTERS TO MEET WORKING PRESSURES UP TO 300 PSIG • ELECTRONIC OR MECHANICAL HI-LO LEVEL ALARM SYSTEMS.*

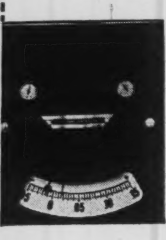
*WRITE DEPT. A-5*

**THE VAPOR RECOVERY SYSTEMS CO.**
**COMPTON, CALIFORNIA, U. S. A.**
*Cable Address: VAREC COMPTON USA (All Codes)*
**New York — Boston — Pittsburgh — Chicago — Detroit**
**St. Louis — Houston — Tulsa — Casper, Wyo. — Provo,**
**Utah — Los Angeles — San Francisco — Seattle**

PROVED and APPROVED "Varec"

P-18





**PRESSURE GAUGES**

• For vacuum, pressure, absolute pressure, and compound vacuum-pressure ranges. Instruments are noted for precision engineered actuating elements which provide maximum accuracy and overload protection with minimum hysteresis effect. Indicators and Recorders furnished in a variety of air-operated and electric control forms. Send for Catalog 7000.

Also Brown Furnace Pressure Controllers for all types of furnaces, kilns, stills and other applications. Write for Bulletin 74-3.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4579 Wayne Ave.,
Phila. 44, Pa.

MINNEAPOLIS
**Honeywell**
*Brown Instruments*

*Manufacturers of*

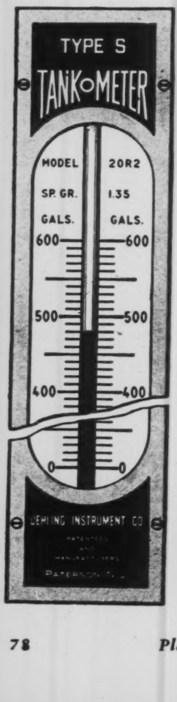
**Precision Dial Pressure Gages**

•

**BEACON GAGE CO.**
11 RIVER STREET
WELLESLEY HILLS 82, MASSACHUSETTS

**UEHLING INSTRUMENT CO.**

PATERSON 3, NEW JERSEY



*INSTRUMENTS FOR MEASURING*
PRESSURE-VACUUM-DRAFT
DIFFERENTIAL PRESSURE
BAROMETRIC PRESSURE
ABSOLUTE PRESSURE
TANK CONTENTS
DEPTH & FLOW

MEASURE AND KNOW

SEND FOR BULLETINS

**GAGES, Pipe**
Sheffield Corp.
Size Control Co.

**GAGES, Pitch Diameter**
Acme Industrial
Brown & Sharpe
**Bryant Chucking Grinder**
Detroit Tap & Tool
DoAll Co.
Federal Prod. Corp.
Fonda Gage Co.
Greenfield Tap & Die
Lufkin Rule Co.
Merz Engineering
Pratt & Whitney
Scherr Co., Inc.
Sheffield Corp.
Size Control Co.
Starrett Co.
Swedish Gage Co.
Union Tool Co.
Van Keuren Co.
Vinco Corp.
West & Dodge Thread
Woodworth Co.

**GAGES, Plug**
Acme Industrial
American Gauge Co.
Amer. Measuring Insts.
Brown & Sharpe
Cadillac Gage Co.
Corning Glass Works
Dearborn Gage Co.
Detroit Tap & Tool
DoAll Co.
Eitzen Co.
Elgin National Watch
Federal Products, Corp.
Fonda Gage
Greenfield Tap & Die
Lawrence & Hill
Merz Engineering
Nilsson Gage Co.
Park Sales Co.
Pratt & Whitney
Precision Gage & Tool
R & M Mfg. Co.
Sheffield Corp.
Size Control Co.
Standard Gage
Swedish Gage
Vinco Corp.
West & Dodge Thr. Gage
Woodworth Co.

**GAGES, Pneumatic Tank**
Bacharach Industrial
Barton Inst. Co.
Foxboro Co.
Liquidometer Corp.
Marsh Corp.
Mason-Neilan Regulator
Parks Co., Harry S.
Pneumercator Co.
Rochester Co.
Uehling Inst. Co.
U. S. Gauge Co.

**GAGES, Precision Measuring**
Acme Industrial
Aero Electronics
Ames Co., B. C.
Amer. Measuring Inst.
Arma Corporation
Barr Instrument
Bethlehem Apparatus
Brown & Sharpe
Bryant Chucking Grinder
**Cadillac Gage Co.**
Comtor Co.
Dearborn Gage Co.
Dice Co., J. W.
DoAll Co.
Eitzen Co.
ElginNational Watch
Engis Equipment
Federal Prod. Corp.
Ferner Co.
Fonda Gage Co.
General Elec. Co.
**Graham-Mintel Inst.**
Jansson Gage Co.
Lufkin Rule Co.
Magnetic Gauge Co.
Martin-Hubbard Corp.
Merz Engineering
Metron Instrument
Moore Products
Nilsson Gage Co.
Phoenix Prec. Inst.
Physicists Research
Poole Instruments
Pratt & Whitney
Rieker Instrument Co.
Rockwell Engr.
Saart, Kraemer & Hanscom
Scherr Co., Inc.
Sheffield Corp.
Size Control Co.
Standard Gage
Starrett Co.
Stocker & Yale
Swedish Gage
Thwing-Albert Inst. Co.
United Precision Prod.
Van Keuren Co.
Vinco Corp.
Webber Gage Co.
Wilmotte, Inc.
Woodworth Co.
Carl Zeiss, Inc.

**GAGES, Pressure, Indicating**
Acragage
Aeromarine Inst. Co.
Aeroquip Corp.
American Chain & Cable
American Meter Co.
Bacharach Industrial Ints
Bailey Meter Co.
Baird Meter Co.
Baird Associates
Baldwin Locomotive
Bastian-Blessing
(Continued)
Beacon Gage Co.
Bethlehem Apparatus
Block Mfg. Co.
Boekel & Co.
Bristol Co.
Bryant Chucking Grinder
Brush Development Co.
Builders-Providence
Central Scientific Co.
Clark Blast Meter
Cleveland Fuel Equip.
Coleman Inst. & Mfg.
Commerical Research
Consolidated Engg.
Continental Elec. Co.
Crosby Steam Gage
Dayton-Rogers Mfg. Co.
Defender Automatic Reg.
Dickson Co.
Dillon & Co.
Distillation Products
Dwyer Mfg. Co.
Eclipse-Pioneer Div.
Electric Auto-Lite
Electro-Mec Lab.
Electro Products Labs.
Electronic Products Co.
Elematic Equip. Corp.
Ellison Draft Gage
Emery Co., A. H.
Engineering Research & Dev.
Esterline-Angus Co.
Fisher Scientific Co.
Foxboro Co.
Fredericks, Co., George
**Friez Instrument**
Fulton Sylphon Div.
Gas Appliance Specialties
General Elec. Co.
General Physical Lab.
Giannini & Co.
Gordon Co., Claud S.
Gotham Inst.
Gulton Mfg.
Hathaway Inst. Co.
Hays Corp.
Heise Bourdon Tube
H & H Thermostats
Kollsman Inst. Div.
Logansport Machine
Lonergan Co.
Magnetic Gauge Co.
Manning, Maxwell & Moore
Mansfield & Green
Marsh Corp.
Marshalltown Mfg. Co.
Mason-Neilan Regulator
Massa Laboratories
Mercoid Corp.
Meriam Instrument
Metron Instrument
Minneapolis-Honeywell
Moeller Instrument Co.
Moore Products
National Research
Nurnberg Thermometer
Pacific Div.
Parks Co., Harry S.
Perfex Corp.
Physicists Research
Podbielniak, Inc.
Precision Gage & Tool
Precision Therm.
Preferred Utilities Mfg.
Process & Instruments
RCA Div.
Refinery Supply Co.
Republic Flow Meters
Rochester Mfg. Co.
Scientific Glass App.
Scientific Inst. Co.
Seely Inst. Co., Inc.
Sheffield Corp.
Skaneateles Mfg. Co.
Statham Labs.
Stewart-Warner Corp.
Stoelting Co., C H
Stokes Machine Co
Superior Meter Co.
Surface Combustion
Sylvania Elec. Prod.
Tagliabue Div.
Taylor Inst. Cos.
Thwing-Albert Inst. Co.
Trans-Sonics, Inc.
Trerice Co.
Trimount Instrument
Uehling Instrument Co.
U. S. Gauge
Universal X-Ray Prods.
Wagner & Son, Carl H.
Wallace & Tiernan (Low Pressure)
Weksler Thermometer
Welch Scientific
Wheelco Instruments
Wiancko Engineering
Wilgus Manufacturing
Winslow Co.
Witt Gage Co.

**GAGES, Pressure—Recording (See Gages, Pressure, Indicating)**

**GAGES, Pressure Temperature (See Ganes, Pressure Indicating)**

**GAGES, Pressure & Vacuum (See Gages, Pressure Indicating)**

**GAGES, Profile**
Acme Industrial
American Gage Co.
Amer. Measuring Insts.
Brush Devlopment
Cadillac Gage Co.
Dearborn Gage Co.
Engineers Specialty Div.
Federal Products Corp.
Fonda Gage
Foxboro Co.
General Elec. Go.
Jansson Gage Co.
Martin-Hubbard Corp.
Merz Engineering
Nilsson Gage Co.
(Continued)

# MARSH PRESSURE GAUGES

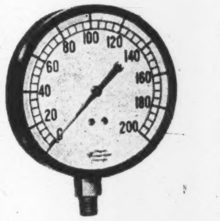
## Mastergauge

Marsh quality, stamina and accuracy, is found in its highest development in the "Mastergauge." Accuracy is guaranteed within 1/2 of 1% of reading. Advanced monel and stainless steel movement and rugged bourdon tube assure lasting accuracy under all conditions. Try the Mastergauge where others have failed. There is one for every service.

### *Only the Marsh has the Recalibrator*

The "Recalibrator" provides the best and quickest method of correcting a gauge that has been knocked out of adjustment. It is available in all Marsh gauges.

### *A Gauge for Every Service*

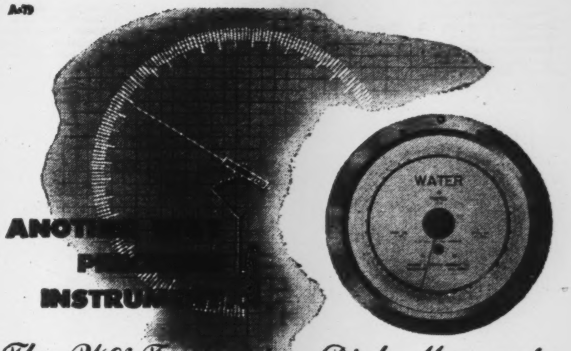


The Marsh line also includes the "quality" gauges for use under severe conditions and the "Standard" gauges for ordinary conditions. The moderately priced "Standard" gauge is illustrated opposite. From "Mastergauge" to "Standard" gauge all Marsh Gauges represent the finest obtainable for the service for which they are recommended.

**JAS. P. MARSH CORPORATION**
**Dept. 8, Skokie, Ill.**

---

A-79



## *The W&T Precision Dial Manometer*

The W&T Precision Dial Manometer answers the problem of conveniently measuring pressure with a sensitivity of 1 part in 10,000.

This sturdy, compact instrument, which is widely used for wind tunnel work, power plant test stands and in gas turbine testing, has a large easy-to-read dial. It is custom calibrated in any pressure units over various ranges up to a maximum of 200 inches of mercury.

In addition, the W&T Precision Dial Manometer possesses these outstanding advantages:

Accuracy .....1 part in 1000
Scale length ..45"
Case ... ......pressure tight, metal for flush mounting.
Full protection against over pressure.
Measures gauge pressure, vacuum and differential pressure.

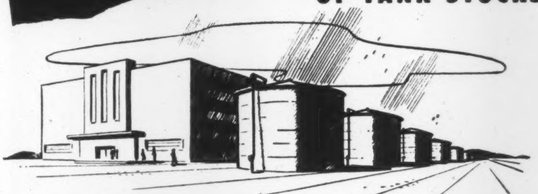
This instrument with its sensitive response and precision results is typical of a wide variety of pressure instruments of all types — from low pressure indicators to altimeters — manufactured by W&T. If you have a problem in pressure measurement, write, telling us the details. We'll be glad to help.

**WALLACE & TIERNAN**
PRODUCTS, INC.
ELECTRICAL MECHANISMS AND PRECISION INSTRUMENTS
Belleville 9 New Jersey • Represented in Principal Cities

---

## *Complete Control*

## OF TANK STOCKS



★ INSTANTANEOUS INVENTORY READINGS!

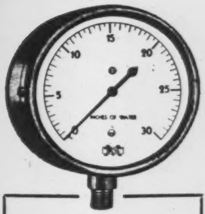
Now, a complete gaging system which eliminates many gaging operations. Eye-level readings at each tank, **plus** electric dials on master control panel always before your operator's eyes — ready to give readings instantly. Easy to install. Accurate. Time Saving. Send for Bulletin No. 148.

**A.O.Smith**
**Corporation**
**METER DIVISION**

FACTORIES: 5715 SMITHWAY ST., LOS ANGELES 22, CALIF. • P.O. BOX 500, SUCCASUNNA, N. J.

---

# MARSHALLTOWN LOW PRESSURE DIAPHRAGM GAUGE



Marshalltown Figure 83 is an extremely sensitive gauge that uses a carefully seasoned bronze diaphragm to accurately measure very low pressures. It is used extensively on many types of natural gas installations for checking the low pressures.

**Write for details and price.**

**LOOK TO MARSHALLTOWN FOR ONE OF THE MOST COMPLETE LINES OF INDICATING PRESSURE GAUGES MADE!**

Available in standard dials (reading in inches of water) 0-15"—0-30"—0-60"—0-100"—0-160" . . . also in ounce graduated dials from 15 ounces to 5 pounds. 2½", 3½" and 4½" dial sizes mounted in black enameled deep steel case.

**MARSHALLTOWN MANUFACTURING CO.**
**MARSHALLTOWN, IOWA**

Physicists Research
Pratt & Whitney
Precision Gage & Tool
Sheffield Corp.
Size Control Div.
Stocker & Yale
Swedish Gage Co.
Vinco Corp.
Woodworth Co.

### GAGES, Radius
Acme Industrial
American Meas. Insts.
Brown & Sharpe
Cadillac Gage Co.
Dearborn Gage Co.
Federal Products Corp.
Fonda Gage Co.
Lovins Engr.
Lufkin Rule Co.
Nilsson Gage Co.
Sheffield Corp.
Size Control Co.
Starrett Co.
Stocker & Yale
Swedish Gage Co.
Vinco Corp.
Wilmotte, Inc.
Woodworth, Co.

### GAGES, Rain (See Rain Gages)

### GAGES, Rifle Bore
Baldwin Locomotive
Federal Products Corp.
Fonda Gage Co.
Hathaway Inst. Co.
Moore Products
Nilsson Gage Co.
Poole Instruments
Pratt & Whitney
Sheffield Corp.
Vinco Corp.

### GAGES, Ring
Acme Industrial
Allen Gauge & Tool Co.
American Gage Co.
Amer. Measuring Insts.
Brown & Sharpe
Bryant Chucking
Cadillac Gage Co.
Corning Glass Works
Dearborn Gage Co.
Detroit Tap & Tool
Elgin National Watch
Greenfield Tap & Die
Johnson Gage Co.
Lawrence & Hill
Merz Engineering
Nilsson Gage Co.
Park Sales Co.
Pratt & Whitney
Precision Gage & Tool
Sheffield Corp.
Size Control Co.
Standard Gage
Swedish Gage Co.
Vinco Corp.
West & Dodge Thread
Woodworth Co.
Worley Jewel Co.
Zeiss, Inc., Carl

### GAGES, Screw Thread
Acme Industrial
Allen Gauge & Tool Co.
Brown & Sharpe
Bryant Chucking
Cadillac Gage Co.
Detroit Tap & Tool
Federal Prod. Corp.
Fonda Gage Co.
Greenfield Tap & Die
Jansson Gage Co.
Johnson Gage Co.
Lufkin Rule Co.
Merz Engineering
Millers Falls Co.
Pratt & Whitney
Sheffield Corp.
Size Control Co.
Starrett Co.
Swedish Gage Co.
Vinco Corp.
West & Dodge Thread
Woodworth Co.
Zeiss, Inc., Carl

### GAGES, Sliding
Acme Industrial
Amer. Measuring Insts.
Barr Instrument
Lufkin Rule Co.
Pratt & Whitney
Size Control Co.
Van Keuren Co.

### GAGES, Snap
Acme Industrial
Allen Gauge & Tool Co.
American Gage Co.
American Measuring Insts.
Barr Instrument
Brown & Sharpe
Cadillac Gage Co.
Dearborn Gage Co.
Detroit Tap & Tool
Federal Products Corp.
Fonda Gage Co.
Gen. Engg. & Model Wks.
Greenfield Tap & Die
Jansson Gage Co.
Johnson Gage Co.
Lawrence & Hill
Merz Engineering
Metzger & Son
Nilsson Gage Co.
Pratt & Whitney
Precision Gage & Tool
Scherr Co.
Sheffield Corp.
Size Control Co.
Standard Gage
Swedish Gage Co.
Vinco Corp.

### GAGES, Spline
Acme Industrial
American Meas. Insts.
Brown & Sharpe
Federal Products Corp.
Merz Engineering
Pratt & Whitney
Precision Gage & Tool
Sheffield Corp.
Size Control Co.
Standard Gage
Vinco Corp.

### GAGES, Star
Federal Products Corp.
Moore Products
Pratt & Whitney
Sheffield Corp.

### GAGES, Strain
Acme Industrial
American Inst. Co.
Anderson, Arthur R.
Bailey Meter Co.
Baldwin Locomotive
Pacific Div.
Dillon & Co.
Edin Electronics
Eitzen Co.
Electronic Products Co.
Federal Products Corp.
General Elec. Co.
Giannini & Co.
Gulton Mfg.
Hathaway Inst. Co.
Hays Corp.
Heiland Research
Metzer & Son
Miller Corp., Wm.
Olsen Testing Machine
Pratt & Whitney
Reed Research
Riehle Testing Mach.
Starrett Co.
Statham Labs.

### GAGES, Stream
Leupold & Stevens

### GAGES, Surface
Acme Industrial
American Meas. Insts.
Ames Co., B. C.
Barr Instrument
Blake Co., Edward
Brown & Sharpe
Brush Development
Comtor Co.
Dearborn Gage Co.
Edin Electronics
Federal Products Corp.
Genales, Andrew
Jansson Gage Co.
Lufkin Rule Co.
Millers Falls Co.
Optron Laboratory
Palos Optical Co.
Physicists Research
Precision Scientific
Standard Gage
Starrett Co.
Swedish Gage
Zeiss, Inc., Carl

### GAGES, Surface Finish Checking
Blake Co., Edward
General Electric
Link Eng. & Mfg.
Physicists Research
Surface Checking Gage

### GAGES, Taper
Acme Industrial
American Gage Co.
Brown & Sharpe
Cadillac Gage Co.
Dearborn Gage Co.
Elgin National Watch
Federal Prod. Corp.
Fonda Gage Co.
General Electric
Greenfield Tap & Die
Lincoln Park Tool
Merz Engineering
Micro Master Co.
Moore Products
Nilsson Gage Co.
Poole Instruments
Precision Gage & Tool
Pratt & Whitney
Sheffield Corp.
Size Control Co.
Standard Gage
Starrett Co.
Swedish Gage
Vinco Corp.
Woodworth Co.

### GAGES, Telescoping
Brown & Sharpe
Federal Products Corp.
Lufkin Rule Co.
Starrett Co.
Swedish Gage Co.

### GAGES, Thickness
Aero Electronics
American Inst. Co.
Ames Co., B. C.
Amthor Testing Inst. Co.
Automatic Temp. Control
Branson Instruments
Brown & Sharpe
Canadian Radium
Commercial Research
Dearborn Gage Co
Dice Co., J. W.
Edin Electronics
Elgin National Watch
Federal Prod. Corp.
Fonda Gage Co.
Glogau & Co.
Gen. Engg. & Model Wks.
General Elec. Co.
Hathaway Inst. Co.
Ill. Testing Labs.
Industrial Electronics
Industrial Nucleonics
Instrument Dev. Labs.
Krouse Testing Machine
Lawrence & Hill
Lufkin Rule Co.
Marshall Co.
Merz Engineeringg
Metzger & Son
Millers Falls Co.
Moore Products
Photocon Research
Poole Instruments
Pratt & Whitney
Precision Gage & Tool
Precision Scientific Co.
Precision Therm. & Inst.
Saart, Kraemer & Hanscom
Scott Testers
Sheffield Corp.
Size Control Co.
Speidel & Co.
Sperry Products, Inc.
Standard Gage
Starrett Co.
Swedish Gage
Thwing-Albert Inst. Co.
Tracerlab Inc.
Van Keuren Co.
Waltham Dial Gage
Westinghouse Elec.
Woodworth Co.

### GAGES, Thickness, Magnetic
Aero Electronics
American Inst. Co.
Commercial Research
Electric Eye Equip.
General Elec. Co.
Hathaway Inst. Co.
Hickok Elec. Inst. Co.
Krouse Testing Machine
Metron Instrument
Pratt & Whitney
Schaevitz Engg.
Sheffield Corp.

### GAGES, Thickness, Ultrasonic
Branson Instruments, Inc.
Dice Co., J. W.
DoAll Co.
Gulton Mfg. Co.
Magneflux Corp.
Sheffield Corp.

### GAGES, Thread
Acme Industrial
Bryant Checking
Fonda Gage
Johnson Gage Co.
Pratt & Whitney
Sheffield Corp.
Size Control Co.
Swedish Gage Co.

### GAGES, Torque
Aero Electronics
Airdraulics Engineering
General Elec. Co.
Hagan Corp.
Hathaway Inst. Co.
Manning, Maxwell & Moore
Martin Decker Corp.
Metron Instrument
Pelouze Mfg. Co.
Riehle Div.
Schaevitz Engg.
Statham Labs.
Sturtevant Co.
Toledo Scale Co.

### GAGES, Vacuum (See Gages, Pressure)

### GAGES, Venturi (See Flow Meters, Venturi)

### GAGES, Vibration
Electro Products Labs.
Gulton Mfg. Co.
Industrial Electronics
Panoramic Radio Products
Scott, Inc., H. H.
Sheffield Corp.
Statham Labs.
Walkirt Co.
Wiancko Engineering

### GAGES, Water Level (See GAGES, Liquid Level)

### GAGES, Wind
Aero Electronics
American Inst. Co.
Bacharach Ind. Inst.
Electric Speed Ind.
Friez Inst. Div.
Green, Henry J.
Hastings Inst. Co.
Illinois Testing Labs.
Instruments Corp.
Kenyon Inst. Co.
Leupold & Stevens
Rieker Inst. Co.
Stewart, M. C.
Taylor Inst. Cos.
Thomas Co., Arthur H.

### GAGES, Wire Measuring
Amer. Measuring Insts.
Ames Co., B. C.
Brown & Sharpe
Elgin National Watch
Federal Prod. Corp.
Foxboro Co.
General Elec. Co.
Greenfield Tap & Die
Hathaway Inst. Co.
Merz Engineering
Moore Products
Nilsson Gage Co.
Pratt & Whitney
Sheffield Corp.
Starrett Co.
Swedish Gage Co.

### GAGING FIXTURES
Acme Industrial
Amer. Measuring Insts.
Allen Gauge & Tool Co.
Daco Machine & Tool
Dearborn Gauge Co.
Eitzen Co.
Electric Eye Equip.
Elgin National Watch

(Continued)

Federal Products Corp.
Fonda Gage Co.
Jansson Gage
Lawrence & Hill
Lincoln Park Industries
Link Engineering
Merz Engineering
Saart, Kraemer & Hanscom
Ryan Tool and Engg.
Size Control Co.
Stocker & Yale
Swedish Gage
Waltham Dial Gage
Wilmotte, Inc.
Woodworth Co.

### GALVANOMETERS, A-c.
Assembly Products
Associated Research
Brush Development Co.
Cambridge Inst. Co.
Central Scientific Co.
Century Geophysical
Cole Instruments
Consolidated Engg.
Dale Instruments
Edin Electronics
General Elec. Co.
General Radio Co.
Gilman Scientific
Hathaway Inst. Co.
Heiland Research Corp.
Hickok Elec. Inst.
Leeds & Northrup Co.
Metron Instrument
Pfaltz & Bauer, Inc.
Rawson Electrical Inst.
RCA Manufacturing
Roller-Smith Co.
Rubicon Co.
Sensitive Research Inst.
Tagliabue Div.
Welch Mfg. Co.
Weston Elec. Inst.
Wheelco Inst. Co.

### GALVANOMETERS, Astatic
Cambridge Inst. Co.
Central Scientific Co.
Chicago Apparatus Co.
Cole Instrument
Dale Instruments
Hathaway Inst. Co.
Leeds & Northrup Co.
Rawson Electrical Inst.
Ruska Instrument
Sensitive Research Inst.
Welch Scientific
Westinghouse Elec.
Wheelco Inst. Co.

### GALVANOMETERS, D-c.
Assembly Products
Associated Research
Brown Inst. Div.
Brush Development Co.
Cambridge Inst. Co.
Central Scientific Co.
Century Gheophysical
Cole Instrument
Coleman Inst. & Mfg.
Consolidated Engg.
Dale Instruments
DeJur-Amsco
Edin Electronics
Edison Elec. Controls
Electric Des. & Eng.
Electronic Development
Engelhard, Charles
General Electric
Gilman Scientific
G-M Labs.
Hathaway Inst. Co.
Heiland Research
Hickok Elec. Inst.
Jarrell-Ash Co.
J-B-T Instrument Co.
Leeds & Northrup Co.
Marion Electric Inst.
Meters, Inc.
Metron Instrument
Rawson Electrical Inst.
RCA Manufacturing Co.
Roller-Smith Co.
Rubicon Co.
Sanborn Co.
Sensitive Research Inst.
Shallcross Mfg. Co.
Simpson Elec. Co.
Southwestern Ind. Elec.
Taco West Corp.
Tagliabue Div.
Thwing-Albert Inst.
Triplett Electrical Inst.
Welch Scientific
Westinghouse Elec.
Weston Elec. Inst. Corp.
Wheelco Inst. Co.
Winslow Co.

### GALVANOMETERS, Reflecting
Associated Research
Brush Development
Century Geophysical
Cole Instrument
Coleman Instrument
Consolidated Engg.
General Electric Co.
G-M Laboratories
Hathaway Inst. Co.
Heiland Research
Jarrell-Ash Co.
Leeds & Northrup
Pfaltz & Bauer
Rawson Electrical Inst.
Rubicon Co.
Ruska & Co.
Sanborn Co.
Southwestern Ind. Elec.
Sprengnether Inst. Co.
Thwing-Albert Inst. Co.

### GALVANOMETERS, Vacuum-tube
Beckman Insts.
Cole Instrument

(Continued)

Electronic Div. Lab.
Electro Products Lab.
Engineering Labs., Inc.
General Radio
Harvey Radio Labs.
Hathaway Instrument Co.
Heiland Research
MacDonald Co., W. S.
Measurements Corp.
RCA
Rockwell Engr.
Sanborn Co.
Tagliabue Div.
Varo Mfg. Co.

### GALVANOMETERS, Vibration
Century Geophysical
Consolidated Engg.
Hathaway Inst. Co.
Leeds & Northrup

### GALVANOSCOPES
Central Scientific Co.
Stoelting Co., C. H.
Welch Scientific

### GAS ANALYZERS, Air
Burrell Technical Supply
Cambridge Inst. Co.
Central Scientific Co.
Cook Electric
Davis Emergency Equip.
Fish-Schurman Co.
Fisher Scientific Co.
Friez Div.
General Elec. Co.
Hays Corp.
Hebler Co.
Mercoid Corp.
Mine Safety Appliances
Perkin-Elmer Corp.
Permutit Co.
Process & Instruments
Refinery Supply Co.
Sargent & Co.
Scientific Glass App.
Tagliabue Div.
Wilson Products, Inc.

### GAS ANALYZERS, Ammonia
Baird Associates
Burrell Technical Supply
Cambridge Inst.
Davis Emergency Equip.
Engelhard, Chas.
General Elec. Co.
Hays Corp.
Hebler Co.
Mercoid Corp.
Perkin-Elmer Corp.
Permutit Co.
Process & Instruments
Sargent & Co.
Tagliabue Div.

### GAS ANALYZERS, Carbon Dioxide
Ace Glass, Inc.
Bacharach Industrial Inst.
Baird Associates
Burrell Tech. Supply
Cambridge Inst. Co.
Central Scientific Co.
Davis Emergency Equip.
Defender Inst. & Reg.
Dwyer Mfg. Co.
Ellison Draft Gage Co.
Engelhard, Chas.
Fish-Schurman Co.
Fisher Scientific
Friez Instrument
General Elec. Co.
Gordon Co., Claud S.
Gow-Mac Instrument
Hays Corp.
Hebler Co.
Laboratory Equip. Co.
Leeds & Northrup Co.
Liston-Folb
Machlett & Son
Mine Safety Appliances
Perkin Elmer Corp.
Permutit Co.
Podbielniak, Inc.
Potter Co.
Precision Therm.
Preferred Utilities Mfg.
Process & Instruments
Refinery Supply Co.
Republic Flow Meters
Sargent & Co.
Scientific Glass App.
Scientific Inst. Co.
Uehling Instrument Co.
Victory Engr. Co.
Viking Instruments
Williams Apparatus Co.

### GAS ANALYZERS, Carbon Monoxide
Bacharach Industrial Inst.
Bailey Meter Co.
Baird Associates
Burrell Technical Supply
Cambridge Inst. Co.
Central Scientific
Chicago Apparatus Co.
Davis Emergency Equip.
Eclipse Aviation
Electric Heat Control
Fish-Schurman Co.
Fisher Scientific
General Elec. Co.
Hays Corp.
Laboratory Equip. Co.
Leeds & Northrup Co.
Liston-Folb
Machlett & Son
Mine Safety Appliances
Perkin-Elmer Corp.
Podbielniak, Inc.
Sargent & Co.
Scientific Glass App.
Scientific Inst. Co.
Taller & Cooper
Will Corporation

### GAS ANAYZERS, Chlorinated Hydrocarbons
Baird Associates
Beckman Insts.
Consolidated Engg.
Davis Emergency Equip.
Engelhard, Chas.
General Elec. Co.
Hebler Co.
Industrial Insts. Inc.
Liston-Folb
Mine Safety Appliances
Perkin-Elmer Corp.
Podbielniak, Inc.
Precision Scientific
Wilson Products, Inc.

### GAS ANALYZERS, Flue Gas (See Gas Analyzers, Carbon Dioxide or Oxygen)

### GAS ANALYZERS, Hydrocarbon
Applied Physics Corp.
Bailey Meter Co.
Baird Associates
Burrell Tech. Sup.
Consolidated Eng.
Davis Emergency Equip.
Distillation Products, Inc.
Engelhard, Chas.
Fisher Scientific
General Elec. Co.
Hebler Co.
Industrial Insts. Inc.
Johnson-Williams, Ltd.
Liston-Folb
Mine Safty Appliances
National Tech. Labs.
Perkin-Elmer Corp.
Podbielniak, Inc.
Precision Scientific

### GAS ANALYZERS, Hydrogen
Bacharach Industrial Inst.
Burrell Technical Supply
Chicago Apparatus Co.
Davis Emergency Equip.
Engelhard, Chas.
Fisher Scientific
General Elec. Co.
Gow-Mac Inst. Co.
Hays Corp.
Hebler Co.
Johnson-Williams, Ltd.
Leeds & Northrup
Mine Safety Appliances
Permutit Co.

### GAS ANALYZERS, Hydrogen Sulphide
American Meter
Baird Associates
Burrell Technical Supply
Cambridge Inst. Co.
Connelly Co.
Consolidated Engg.
Davis Emergency Equip.
Engelhard, Chas.
Fisher Scientific
Hebler Co.
Industrial Inst. Inc.
Mine Safety Appliance
Perkin-Elmer Corp.
Rubicon Co.
Sargent & Co.
Scientific Glass Apparatus

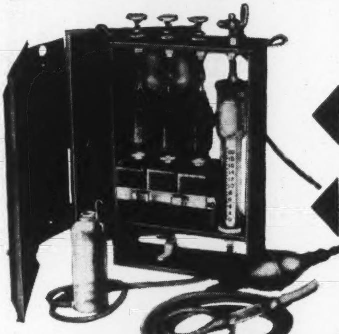
### GAS ANALYZERS, Nitric Oxide
Baird Associates
Beckman, Inc., Arnold O.
Cambridge Inst. Co.
Davis Emergency Equip.
Engelhard, Chas.
Fisher Scientific
General Electric Co.
Hays Corp.
Liston-Folb
Mine Safety Appliances
Perkin-Elmer Corp.
Rubicon Co.
Sargent & Co.

### GAS ANALYZERS, Orsat
Ace Glass, Inc.
Bacharach Ind. Inst.
Bailey Meter Co.
Burrell Technical Supply
Central Scientific Co.
Chicago Apparatus Co.
Defender Automatic Reg.
Dwyer Mfg. Co.
Ellison Draft Gage
Fish-Schurman Co.
Fisher Scientific Co.
Hays Corp.
Howe & French, Inc.
Laboratory Equip. Co.
Machlett & Son
Podbielniak, Inc.
Precision Therm.
Sargent & Co.
Scientific Glass App.
Specialty Glass Co.
Thomas Co., Arthur H.

### GAS ANALYZERS, Oxygen
Bacharach Industrial Inst.
Bailey Meter Co.
Beckman, Inc., Arnold O.
Burrell Technical Supply
Chicago Apparatus Co.
Cambridge Inst. Co.
Davis Emergency Equip.
Eclipse Aviation
Engelhard, Charles
Hays Corp.
Hebler Co.
Laboratory Equip. Corp.
Leeds & Northrup
Mine Safety Appliances
National Tech. Labs.
Podbielniak, Inc.
Precision Scientific
Process & Instruments
Sargent & Co.
Scientific Glass App.
Superior Meter Co.
Tagliabue Div.

# Analyze for $CO, CO_2, O_2$ with one instrument

## HAYS ORSAT GAS ANALYZER



**Complete**—3 absorption units provide complete gas analysis for all the operating engineer's needs.

**Rugged**—built for continuous field use . . . strong, pressed steel construction.

**Portable**—contains everything you need to make a complete analysis . . . in one easy-to-carry case. Compact, yet all parts are easily accessible.

*send for bulletin 49-668*
*for complete description of all styles.*

The Hays Orsat Type Gas Analyzer is simple, fast, and employs the most reliable method known for obtaining accurate measurement. Available in one, two or three-unit styles (illustrated).

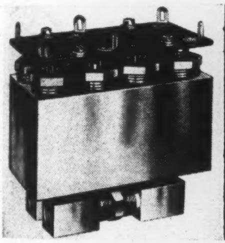
**THE HAYS CORPORATION**
*MICHIGAN CITY 8A, INDIANA*
combustion and industrial instruments and control

---

# NEW DESIGNS PERFORMANCE APPLICATIONS

## In

## GAS INSTRUMENTATION



8 Filament
High Output
Recorder Unit

**GOW-MAC**
*EVER-TITE*
**THERMAL CONDUCTIVITY UNITS**

## —for accuracy, simplicity, speed of response and economy

The practical answer to problems of continuous gas observation involving purity, quantitative change, absorption and other laboratory and process applications. Gow-Mac Sensing Elements are standard equipment in government bureaus, armed service projects, industrial and university research laboratories. Inquiries on specific gas analysis problems will receive prompt attention; no obligation.

*WRITE, today, for new illustrated Gow-Mac 1951 Catalog*

**GOW-MAC INSTRUMENT COMPANY**
22 LAWRENCE STREET, NEWARK 5, NEW JERSEY

---

*An important advancement in chemical analysis instrumentation*

# BECKMAN OXYGEN ANALYZERS

Indicating and Recording

## Based on the unique *paramagnetic property* of Oxygen

*Features*

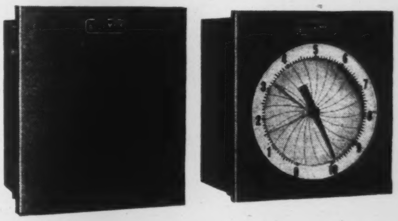
- High accuracy and sensitivity
- Simple to operate
- A physical measurement, not a chemical analysis
- Rapid response
- Small sample rate (50 to 250cc per minute)
- Flow rate independent
- Rugged construction
- Many ranges available

**Model E-2 Beckman Oxygen Analyzers**

Accuracies of ±0.005% $O_2$ attainable with these multi-range instruments. Samples as small as 10 cc readily analyzed. Highest precision portable laboratory oxygen analyzer. Operates on 115 volts, 50/60 cycle.

**Model G-2 Beckman Oxygen Analyzers**

Full scale ranges from 200 ppm to 100% $O_2$ available in this self-balancing, recorder-controller analyzer. Accuracies up to ±0.001% $O_2$ (depending upon range). Self-stanardizing available for automatic compensation of electrical, thermal, background gas, and barometric pressure variations. Ideal for precise process control.



**Model C Beckman Oxygen Analyzers**

Direct reading, single range, general purpose, portable oxygen analyzer. Factory calibration and electrical thermostating provide high accuracy— ±1% of full scale. Minimum range 0-40 mm oxygen partial pressure (0-5% $O_2$). Widely used for medical studies, scientific research, and industrial analyses. Operates on 115 volts 50/60 cycle.

*Other models also available. Send for complete descriptive literature. Our engineering department will gladly make recommendations concerning special applications of our instruments.*

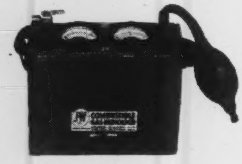
ARNOLD O.
**BECKMAN**
INC.
OXYGEN ANALYZER

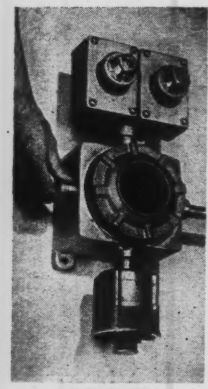
1020 MISSION STREET • SOUTH PASADENA, CALIFORNIA

DETECT combustible GAS

INDICATE • RECORD • CONTROL

J-W Model F Indicator checks the presence of combustible gas at inaccessible locations. Aspirator bulb draws air mixture through sampling hose and probe. Meter registers combustibility instantly. Fully portable, dry-cell operated.


MODEL F


MODEL EE

J-W Models E and EE Alarms monitor fixed installations where explosive hazards may exist. For continuous operation from standard 115-v a-c line. Actuate audible or visual signals, control valves or motors. Model EE is explosion proof. Model E is for installation remote from sensing unit.

J-W Sentinel Alarm serves as a fire-danger watch-dog under conditions of special localized combustible-gas hazard—such as: welding, electrical work, tank cleaning, etc. Storage-battery operated, inbuilt charger, penetrating audible alarm.

SENTINEL

Other models available for laboratory, oil-well logging, and other specialized uses. Your inquiry is invited on designs to meet particular requirements.

Standard for over 25 years

JOHNSON-WILLIAMS LTD.
PALO ALTO · CALIFORNIA
2671-A THIRD STREET

**GAS ANALYZERS, Oxygen & Nitrogen Apparatus**
Bailey Meter Co.
Boekel & Co.
Burrell Technical Supply
Cambridge Inst. Co.
Central Scientific Co.
Davis Emergency Equip.
Fisher Scientific
Hays Corp.
Hebler Co.
Laboratory Equip. Co.
Leeds & Northrup
Mine Safety App. Co.
Podbielniak, Inc.
Precision Scientific
Process & Instruments
Sargent & Co.
Scientific Glass App.
Tagliabue Div.

**GAS ANALYZERS, Sulphur Dioxide**
Bacharach Industrial Inst.
Baird Associates
Burrell Tech. Sup.
Cambridge Inst. Co.
Davis Emergency Equip.
Engelhard, Chas.
Fish-Schurman Co.
Hays Corp.
Hebler Co.
Laboratory Equip. Co.
Leeds & Northrup Co.
Perkin-Elmer Corp.
Precision Scientific
Sargent & Co.
Scientific Glass App.
Skaneateles Mfg. Co.
Uehling Instrument Co.

**GAS APPARATUS, Orifice Well Tester**
Refinery Supply Co.

**GAS DENSITY METERS**
American Meter Co.
Central Scientific Co.
Ess Inst. Co.
Hagan Corp.
Permutit Co.
Precision Therm.
Refinery Supply Co.
Thomas Co., Arthur H.

**GAS FLOW INDICATORS**
Airflow Instrument
American Meter Co.
Askania Regulator Co.
Bacharach Industrial Inst.
Bailey Meter Co.
Bristol Co.
Brooks Rotameter
Builders-Providence
Commercial Research
Fisher & Porter
Fish-Schurman Co.
Foxboro Co.
Hagan Corp.
Hays Corp.
Mason-Neilan Regulator
Meriam Co.
National Inst. Labs.
Phoenix Prec. Inst.
Precision Scientific Co.
Republic Flow Meters
Schutte & Koerting
Selas Company
Simplex Valve & Meter
Statham Labs.
Taylor Inst. Cos.
Victory Engr. Co.

**GAS HOLDER POSITION INDICATORS**
Bailey Meter Co.
Bristol Co.
Electric Indicator Corp.
Elec. Tachometer Corp.
Foxboro Co.
Hagan Corp.
Republic Flow Meters
Zuhr, Inc., Henry

**GAS LEAK INDICATORS**
Aircraft Electronics
Baird Associates
Bullard Co.
Consolidated Engg.
Darley Co., W. S.
Davis Emergency Equip.
Detectron
Distillation Products
Fischer & Porter
Fisher Res. Lab.
Foxboro Co.
General Elec. Co.
Gilmore, E. R.
Globe Phone Mfg. Co.
Goldak Co.
Heiland Research Corp.
Johnson-Williams. Ltd.
Kahl Scientific Inst.
Mine Safety Appliances
Moore Products
Municipal Inst.
National Research
Skaneateles Mfg. Co.
Taylor Inst. Cos.
Vacuum Electronics
Victory Engr.
Water Leak Detector Co.

**GAS METERS, INFERENTIAL—Area (See Flowmeters, Area)**

**GAS METERS, INFERENTIAL—Flow Nozzle (See Flowmeters, Orifice and Nozzle)**

**GAS METERS, INFERENTIAL—Orifice (See Flowmeters, Orifice and Nozzle)**

**GAS METERS, INFERENTIAL—Pitot-tube (See Flowmeters, Pitot-tube)**

**GAS METERS, INFERENTIAL—Venturi (See Flowmeters, Venturi)**

**GAS METERS, POSITIVE, Bellows, Slide-valve**
American Meter Co.
Bristol Co.
Littelfuse Inc.
Sprague Meter Co.
Superior Meter Co.

**GAS METERS, POSITIVE, Rotary**
Revere Co.
Superior Meter Co.

**GAS METERS, POSITIVE, Special for extremely small flows**
American Meter Co.
Brooks Rotameter
Detroit Air Meter Co.
Superior Meter Co.

**GAS METERS, POSITIVE, Wet-drum**
American Meter Co.
Precision Scientific Co.
Superior Meter Co.

**GAS & VAPOR DISCHARGE TUBES, Argon**
Amglo Corp.
Continental Electric
DuMont Labs., Inc., A. B.
Eclipse-Pioneer
General Electric
General Physical Lab.
Jarrell-Ash Co.
Morgan Instrument
Raytheon Mfg.
Skaneateles Mfg.
Sylvania Elec. Prod.

**GAS & VAPOR DISCHARGE TUBES, Carbon Dioxide**
Fredericks, George
**Friez Instruments**
General Electric
General Physical Lab.
Hanovia Chem. & Mfg.
Jarrell-Ash Co.
Skaneateles Mfg. Co.

**GAS & VAPOR DISCHARGE TUBES, Hydrogen**
Baird Associates
General Physical Lab.
Hanovia Chem. & Mfg.
Jarrell-Ash Co.
Skaneateles Mfg. Co.
Sylvania Elec. Prod.

**GAS & VAPOR DISCHARGE TUBES, Mercury**
American Inst. Co.
Amglo Corp.
Bausch & Lomb
Central Scientific Co.
Continental Electric Co.
Electronic Products
Fish-Schurman Co.
Fredericks, George
Gaertner Scientific
Gen. Elec. Lamp Dept.
General Physical Lab.
**Hanovia Chem. & Mfg.**
Jarrell-Ash Co.
Leitz, Inc.
Machlett & Son
Menlo Research Lab
Mico Instrument
Pfaltz & Bauer
Precise Measurements
Raytheon Mfg.
Skaneateles Mfg. Co.
Universal X-Ray Prods.

**GAS & VAPOR DISCHARGE TUBES, Neon**
Amglo Corp.
Central Scientific Co.
Continental Electric
Eclipse-Pioneer
Electronic Products
Fredericks, George
Gen. Elec. Co.
General Physical Lab.
Jarrell-Ash Co.
Machlett & Son
Morgan Instrument
Skaneateles Mfg. Co.
Universal X-Ray Prods.

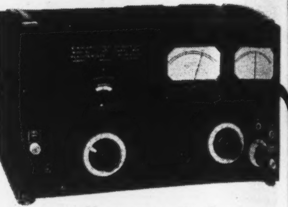
**GAS & VAPOR DISCHARGE TUBES, Nitrogen**
Central Scientific Co.
Electronic Products
Fredericks, George
General Physical Lab.
Skaneateles Products

**GAS & VAPOR DISCHARGE TUBES, Sodium**
Central Scientific Co.
Fredericks, George
Gaertner Scientific Corp.
Gen. Elec. Co.
General Physical Lab.
Jarrell-Ash Co.
Leitz, Inc.
Pfaltz & Bauer, Inc.
Skaneateles Mfg. Co.
Zeiss, Inc., Carl

**GASOLINE MILEAGE TESTER (For automobile and trucks) (See Meters, Mileage)**

**GAUGES see Gages**

**GAUSSMETERS**
Electro-Tech Equipment
Laboratory for Electronics
Sensitive Research


Measurements Corporation
MODEL 80

STANDARD SIGNAL GENERATOR

2 Mc. to 400 Mc.

Individually Calibrated Direct-Reading Dial

FREQUENCY ACCURACY: ±0.5%

OUTPUT VOLTAGE: 0.1 to 100,000 microvolts.

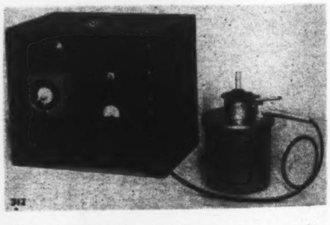
OUTPUT IMPEDANCE: 50 ohms.

MODULATION: Amplitude modulation 0 to 30%. Internal modulation 400 and 1000 cycles. Provision for external pulse and amplitude modulation.

POWER SUPPLY: 117 volts, 50/60 cycles. 70 watts.

MEASUREMENTS CORPORATION
BOONTON NEW JERSE

Ultrasonic Generator



For industrial and laboratory applications, this new and improved Model 800 has a wide frequency range (450-2000 kc.) and an adjustable power output up to 500 watts. The versatile crystal transducer is mounted in a sealed aluminum vessel, with vertical neck serving as a treatment chamber and permitting the continuous-flow method. For repetitive uniform-duration dosages, an automatic timer is also provided.

SEND FOR BULLETINS on this and other instruments.

Ultrasonic Engineering Co.

P. O. Box 46 Maywood, Illinois

NEW! IMPROVED

GAS ANALYZERS AND GAS ALARM SYSTEMS

for

1. COMBUSTIBLE GASES AND VAPORS
2. TOXIC GASES IN LOW CONCENTRATIONS
3. GAS PROPORTIONING AND CONTROL
4. OXYGEN ANALYSIS

Specialists in instrumentation utilizing three basic principles:

Catalytic Combustion
Electro-Conductivity
Thermal Conductivity

A Typical Recording Catalytic Combustion Gas Analyzer

INSTRUMENT DAVIS DIVISION

DAVIS INSTRUMENTS
A Division of Davis Emergency Equipment Co., Inc.
80 Halleck Street
Newark 4, N. J.

**GEAR MEASUREMENT & TEST INDICATORS & RECORDERS**
Brown & Sharpe
Brush Development
Engineering Res. & Dev.
Ferner Co.
Fellows Gear Shaper
Martin-Hubbard Corp.
Physicists Research
Scherr Co., Inc.
Size Control Co.
Vinco Corp.

**GEIGER-MULLER COUNTERS, (See Counter, Geiger-Muller)**

**GEIGER-MULLER TUBES (See Counter, Geiger-Mueller)**

**GENERATORS, A-c.**
Columbia Elec. Mfg.
Eclipse Pioneer
Eicor, Inc.
Electric Indicator
Electronic Instrument
Georator Corp.
Hewlett-Packard
Holtzer-Cabot
Servo Corp.

**GENERATORS, Complex Wave**
Berkshire Laboratories
Marconi Insts., Ltd.

**GENERATORS, D-c.**
Columbia Elec. Mfg.
Eclipse Pioneer
Electric Indicator
Electronic Instrument
Georator Corp.
Globe Industries
Gothard Mfg.
Holtzer-Cabot
Servo Tek Products

**GENERATORS, Pulse**
Berkeley Scientific
Berkshire Laboratories
Cole Instrument
Electronic Instrument
Empire Devices, Inc.
Feiler Engineering
General Radio
Hewlett-Packard
Kay Electric Co.
Lavoie Labs.
Marconi Insts., Ltd.
Measurements Corp.
Potter Instrument Co.
Rutherford Electronics

**GENERATORS, SIGNAL**
Aircraft Radio Corp.
American Time Prods.
Automatic Elec. Chicago
(Continued)
Boonton Radio Corp.
Borden Engineering
**Browning Labs.**
Burke Electric Co.
Clarke Inst. Corp.
Cardwell Mfg. Co.
Clough-Brengle Co.
Collins Radio Co.
Control Corp
Crystal Research Labs.
Communication Meas. Lab.
Electric Indicator Co.
Electro Engrg. Products
Electronic Instruments
Espey Mfg.
**Federal Telephone**
Ferris Inst. Corp.
General Elec. Co.
General Radio Co.
General Test Equip.
**Harvey Radio Labs.**
Hewlett-Packard
Hickok Elect. Inst.
Jackson Electrical Inst.
Kay Electric
**Kellogg Switchboard**
M. B. Mfg. Co.
Measurements Corp.
Millen Mfg. Co.
National Co.
Phillips Petroleum
Precision Apparatus Co.
Premier Crystal Lab.
Radio City Products Co.
RCA Div.
Rollin Co.
Sherron Metallic
Simpson Electric
Sperry Gyroscope Co.
Sylvania Elec. Prod.
Televiso Co.
Triplett Electrical Inst.
United Electronics
Walkirt Co.

**GENERATORS, Square Wave**
Berkshire Laboratories
Borden Engineering
Browning Laboratories
Electro-Mechanical Res.
Electronic Instrument
Empire Devices, Inc.
Feiler Engineering
Hewlett-Packard
Kay Electric Co.
Marconi Insts. Ltd.
Measurements Corp.
Potter Instrument
Servo Corp.
Tektronix, Inc.
Triumph Mfg.
Walkirt Co.

**GENERATORS, Sweep Frequency Signal**
Browning Laboratories
Clarkstan Corp.
Electronic Instrument
Feiler Engineering
Kay Electric Co.
Laboratory for Electronics
Marconi Inst., Ltd.
Polytechnic Res. & Dev.
Precision Apparatus Co.
Radioactive Products

**GENERATORS, Sweep Frequency Audio**
Audio Tone Oscillator
Clough-Brengle
Kay Electric
Marconi Insts., Ltd.
Panaramic Radio Products
Radioactive Products

**GENERATORS, Synchro**
Doelcam Corp.
Ford Instrument
Sperry Gyroscope

**GENERATORS, Ultrasonic**
Engineering Res. & Dev.
General Electric
Gen. Precision Lab.
General Radio
Gulton Mfg. Co.
Hewlett-Packard
Kay Electric Co.
Scott Inc., H. H.
Ultrasonic Engr. Co.

**GEOPHONES**
**Brown Geophysical**
**Century Geophysical**
**Geophysical Instrument** Co.
Geotechnical Corp.
**Globe Phone Mfg. Co.**
**Hathaway Inst. Co.**
**Heiland Research Corp.**
**Massa Laboratories**
**Southwestern Ind. Elec.**
**Varo Mfg. Co.**

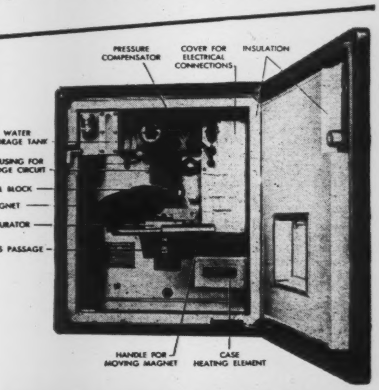
**GEOPHYSICAL INSTRUMENTS**
Aero Electronics
American Inst. Co.
Associated Research
Berkeley Instruments
Borden Engineering
Brown Geophysical
Brush Development Co.
Cambridge Inst. Co.
Century Geophysical
Consolidated Engg.
Electro-Mechanical Research
Engineering Labs., Inc.
Ferner Co.
Geophysical Inst. Co.
Geotechnical Corp.
Goldak Co.
(Continued)

Proved accurate in many fields

HAYS Magno-Therm OXYGEN ANALYZER

Operating on an entirely new principle, based on the paramagnetic property of oxygen, the Hays Oxygen Analyzer *has proved that it measures oxygen with sustained accuracy and dependability.* It has been tested under conditions of extreme severity—in oil refining, on catalyst regenerators; in the chemical field for measuring $O_2$ and $CO_2$; for soaking pits, annealing and heat treating furnaces; wherever dangerous explosive gases are present; and for determining combustion efficiency in boiler rooms.

For the complete story, send for Bulletin 48-829.



The HAYS CORPORATION
COMBUSTION & INDUSTRIAL INSTRUMENTS & CONTROLS
MICHIGAN CITY, INDIANA, U.S.A

**GLASS**

▶ CYLINDERS
▶ TUBES
▶ RODS
▶ CIRCLES &
SPECIAL SHAPES

**FABRICATED and CUT to Your SPECIFICATIONS**

*Your Inquiries Invited*

**CRYSTAL GLASS TUBE & CYLINDER CO.**
436 E. 71st Street Chicago 19, Ill.

GLASS TUBES AND RODS FOR SCIENTIFIC USE—LAMPS, FURNITURE, LIGHTING & DECORATIVE FIXTURES—DISPLAY DOMES—CONTRACT CUTTERS OF TUBE AND ROD.

Hastings Inst. Co.
Hathaway Inst. Co.
Heiland Research Corp.
Hewlett-Packard
Houston Technical
Inst. Development Labs.
Kay Electric
Martin-Hubbard Corp.
Massa Laboratories
Metron Instrument
Mico Instrument Co.
Potter Instrument
Radiation Counter Labs.
Ruska Inst. Corp.
Sensitive Research Inst.
Southwestern Ind. Elec.
Stratex Instrument Co.
Televiso Co.
Trimount Inst. Co.

**GEOPHYSICAL INSTRUMENTS, Gravity Meters**
Atlas Exploration Co.
Brown Geophysical
Century Geophysical
Heiland Research Corp.
Hickok Electrical Inst.
Houston Technical Lab.
National Co.
Potter Instrument
Ruska & Co.

**GEOPHYSICAL INSTRUMENTS, Radioactivity**
Detectron Co.
Douglas Radio Labs.
Georator Corp.
Gulton Mfg. Co.
Midwestern Geophysical
Nuclear Development Lab.
Nuclear Research & Dev.
Nucleonic Corp.
Radiation Counter Labs.
R-C Scientific Inst.
Special Instruments Lab.
Stratex Instrument Co.
Western Radiation Lab.

**GILLMORE NEEDLES (See Needles, Gillmore)**

**GLARE METERS (See Gloss Meters)**

**GLASS, Low Reflecting Surfaces**
Bausch & Lomb
Boehmke Optical Co.
Crystal Research Labs.
Dearborn Scientific
Distillation Products
E & S Optical
Fish-Schurman Corp.
Gaertner Scientific
National Research Corp.
Palos Optical Co.
Plummer & Kershaw
Simpson Optical Mfg.
Unertl Optical Co.
Univis Lens Co.

**GLASS STRAIN TESTERS (See Testers, Glass Strain)**

**GLASS TUBING, Heat Resisting**
Corning Glass Works
Crystal Glass Tube
Electronic Products
Fish-Schurman Co.
Jerguson Gage & Valve
Kimble Glass Co.
Phoenix Precision Inst.
Porter, George K.
Uhrig Co., Joseph F.

**GLASS TUBING, Precision Bore (see Precision—bore Glass Tubing)**

**GLASS TUBING, Ultra-Violet Transmitting**
Continental Electric
Corning Glass Works
Fish-Schurman Co.
General Elec. Co.
Phoenix Precision Inst.
Sampson Chem. & Pigment
Ultra-Violet Products

**GLASS TUBING, Ultra-Violet Transmitting Opaque to Visible Lighting**
Corning Glass Works
Fish-Schurman Co.
General Elec. Co.
Phoenix Precision Inst.
Sampson Chem. & Pigment

**GLASSWARE, LABORATORY (See Apparatus, Laboratory, Glass)**

**GLOSS METERS**
American Inst. Co.
Bausch & Lomb Opt.
Central Scientific Co.
Dearborn Scientific
Gardner Laboratory
Instrument Dev. Labs.
Pfaltz & Bauer, Inc.
Photovolt Corp.
Sensitive Research Inst.
Zeiss, Inc., Carl

**GONIOMETERS**
American Inst. Co.
American Optical
Automatic Temp. Control
Dearborn Scientific
Dusenbery Co.
Ferner Co.
Gaertner Scientific
Gardner Laboratory
General Elec. X-Ray Dept.
Hayes Scientific App.
Jarrell-Ash Co.
RCA Div.
Stocker & Yale
Stratex Instrument Co.
Zeiss, Inc., Carl

**GOVERNORS (See also object of measurement and control)**

**GOVERNORS, Air (See Regulators, Automatic, Air)**

**GOVERNORS, District**
American Meter Co.
Fisher Governor
Foster Engineering
General Controls
Hammel-Dahl Co.

**GOVERNORS, Engine**
Cash Co.
Fisher Governor
General Controls
General Elec. Co.
Hagan Corp.
Mason-Neilan Regulator
Pickering Governor
Robinette Co., W. C.
Synchro-Start Products

**GOVERNORS, Gas (See Regulators, Automatic, Air)**

**GOVERNORS, Hydraulic**
Allis-Chalmers
Cash Co.
Foster Engineering
General Controls
Hagan Corp.
Hammel-Dahl Co.
Mason Neilan Regulator
Milwaukee Prec. Instr.
McAlear Mfg. Co.
Schade Valve Mfg.
Tagliabue Div.

**GOVERNORS, Liquid Level (See Controllers, Automatic, Liquid Level)**

**GOVERNORS, Pressure (See Regulators, Automatic, Air)**

**GOVERNORS, Pump (See Regulators, Automatic, Air)**

**GOVERNORS, Station**
American Meter Co.
Fisher Governor

**GOVERNORS, Steam (See Regulators, Automatic, Air)**

**GOVERNORS, Turbine**
Allis-Chalmers
Askania Regulator Co.
Cash Co.
Foster Engineering
General Elec. Co.
Hagan Corp.
Kieley & Mueller
Mason-Neilan Regulator
Robinnette Co., W. C.
Shallcross Controls

**GRADUATING MACHINES (See Dividing Machines)**

**GRAIN TESTERS (See Testers, Grain)**

**GRANULAR MATERIALS MEASUREMENTS, Level Indicator & Control**
Askania Regulator Co.
Bin-Dicator Co.

**GRANULAR MATERIALS MEASUREMENTS, Particle Size Separator**
American Inst. Co.
Fed. Pneumatic Systems
Gump Co., B.F.
Precision Scientific

**GRANULAR MATERIALS MEASUREMENTS, Volume-Flow Indicators**
Builders-Providence
Dietert Co.
Richardson Scale Co.

**GRANULAR MATERIALS MEASUREMENTS, Volume Integrating Meters**
Bailey Meter Co.
Richardson Scale Co.

**GRANULAR MATERIALS MEASUREMENTS, Weight-Flow Indicators & Recorders**
Bailey Meter Co.
Builders-Providence
Merrick Scale Co.
Omega Machine
Richardson Scale Co.

**GRANULAR MATERIALS MEASUREMENTS, Weight-Integrating Meters**
Bailey Meter Co.
Builders-Providence
Merrick Scale Co.
Omega Machine
Proportioneers, Inc.
Richardson Scale Co.
Toledo Scale Co.

**GRAPHIC (See object of measurement and control)**

**GRATING, Diffraction**
Applied Research Labs.
Baird Associates
Central Scientific Co.
Coleman Instruments
Dearborn Scientific
Dietert Co.
Fish-Schurman Co.
Gaertner Scientific Corp.
G. M. Mfg. Co.
Jarrell-Ash
Laboratory Specialties
Perkin-Elmer Corp.
Welch Scientific

**GRATING, Echelon**
Baird Associates
Gaertner-Scientific Corp.
Jarrell-Ash Co.
Palos Optical Co.

**GRAVIMETERS**
Atlas Exploration Co.
Brown Geophysical
Century Geophysical
Geophysical Inst. Co.
Heiland Research
Mott-Smith Corp.
Western Geophysical

**GRAVITOMETERS**
American Meter Co.
Fisher Scientific
Hagan Corp.
Permutit Co.
Poole Instruments
Refinery Supply Co.

**GRAVITY, Indicators & Recorders**
American Meter Co.
Bailey Meter Co.
Baird Associates
Bristol Co.
Builders-Providence
Century Geophysical
Fielden Instrument
Fischer & Porter
Foxboro Co.
G. M. Mfg.
Hagan Corp.
Hays Corp.
Leeds & Northrup
Moeller Inst. Co.
Moore Products
Permutit Co.
Poole Insts.
Precision Scientific
Precision Thermometer
Refinery Supply
Republic Flow Meters
Ruehfel Co.
Specialty Glass Co.
Schultheis Corp.
Schutte & Koerting
Scientific Instrument
Tagliabue Div.
Taylor Inst. Cos.
Trerice Co.
Wallace & Tiernan

**GREASE TESTING APPARATUS**
American Inst. Co.
Brabender Corp.
Central Scientific Co.
Fish-Schurman Co.
Fisher Scientific Co.
General Electric Co.
Humboldt Mfg. Co.
Koehler Instrument
Precision Scientific Co.
Tagliabue Div.
Televiso Co.

**GROUND DETECTORS**
Automatic Elec. Chicago
General Elec. Co.
Heiland Research
Roller-Smith Co.
Westinghouse Elec.

**GROUND RESISTANCE METERS**
Automatic Elec. Chicago
Associated Research
Biddle Co., Jas. G.
Borden Engineering
General Elec. Co.
Geophysical Inst. Co.
Gray Instrument
Heiland Research Corp.
Industrial Inst. Inc.
Roller-Smith Co.
Shallcross Mfg. Co.
Sticht Co.

**GYRO STABILIZERS**
Arma Corp.
Doelcam Corp.
General Electric Co.
Summers Gyroscope
Vectron, Inc.

**GYROS, Verticle and directional**
Doelcam Corp.
Eclipse-Pioneer
Federal Products
Ford Instrument
Giannini & Co.
Schwien Engr.
Sperry Gyroscope
Vectron, Inc.

**HARDNESS METER, for Plastic Films (See Testers, Hardness of Plastic Films)**

**HARDNESS TESTER (See Testers & Testing Machines, Hardness)**

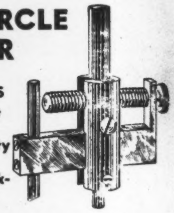
**HARMONIC ANALYZERS**
Electronic Associates
Freed Transformer
Gaertner Scientific Corp.
General Electric Co.
General Radio Co.
Hewlett-Packard
Kay Electric Co.
Keuffel & Esser Co.
Mico Instrument Co.
Scientific Apparatus Co.
United Transformer Corp.

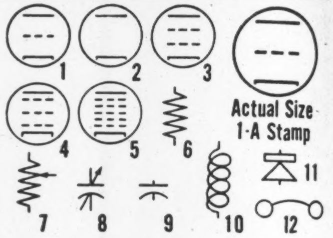
**HELIOSTATS**
Eastern Science Co.
Fecker, Inc.
Gaertner Scientific Corp.

**HIGH ALTITUDE TEST & CALIBRATION CHAMBERS see Chambers, Test & Calibration**

**HIGH-FREQUENCY APPARATUS**
Allis-Chalmers
Boonton Radio Corp.
Clough-Brengle Co.
Collins Radio Co.
Crystal Research Labs.
Electro Engrg. Products
Electro-Mechanical Research
Electronic Dev. Lab.
Empire Devices, Inc.
Federal Telephone Co.
Ferris Inst. Corp.
General Elec. Co.
General Radio
Harvey Radio Labs
International Resistance

(Continued)





**MICRO CIRCLE CUTTER**

FOR METAL
WOOD • PLASTICS

- Micrometer type size control
- Extra heavy duty beam
- Special beam locking mechanism

*At all dealers*

| *Model* | *Type* | *Size* | *Price* |
|---|---|---|---|
| 1 | Round shank | 4 inch | $5.00 |
| 1-A | Square shank | 4 inch | 5.00 |
| 5 | Round shank | 6 inch | 7.50 |
| 10 | Round shank | 14 inch | 15.00 |

These handy rubber stamps provide clear sharp impressions of all the most widely used radio and electrical circuit symbols. Not only saves considerable drawing and drafting time but provides a neater-looking appearance as well. Available in two popular sizes. Stamps may be purchased separately or in complete sets. When ordering, specify stamp number and size.

SIZE A CIRCUIT STAMP SET (12 stamps) $8.50
SIZE A Individual Circuit Stamps each .85
SIZE B* CIRCUIT STAMP SET (12 stamps) 10.00
SIZE B* Individual Circuit Stamps each .95
*Larger size.

**PRECISE COMPANY**
942 Kings Highway, Brooklyn 23, New York

Kay Electric Co.
Lear, Inc.
M. B. Mfg. Co.
McFarlin Co.
Measurements Corp.
Minnesota Electronics
National Co.
Radio Receptor Co.
Raytheon Mfg. Co.
RCA Div.
Servo Corp. of America
Sheffield Corp.
Sherron Metallic
Sperry Gyroscope Co.
Sylvan Electronics Labs.
Thordarson Elec. Mfg.
Walkirt Co.
West Coast Electronics

**HOOK GAGES (See Gages, Hook)**

**HORIZONS, ARTIFICIAL (See Artificial Horizons)**

**HOUR COUNTERS (See Meters, Time)**

**HOUSINGS, Weatherproof, Instrument**
Falstrom Co.
Gilbert & Barker
Lewyt Metal Prods.
Moran Furnace

**HUMIDISTATS**
Automatic Products Co.
Barber-Colman
Friez Instruments
Johnson Service Co.
Minneapolis-Honeywell
Powers Regulator Co.
Sampsel Time Control
Taylor Instrument Cos.

**HUMIDITY INSTRUMENTS, Aspiration (See Psychrometers, Aspiration)**

**HUMIDITY INSTRUMENTS, Conductivimetric**
Friez Inst. Div.
Industrial Insts. Inc.
Leeds & Northrup Co.
Serdex, Inc.

**HUMIDITY INSTRUMENTS, Hygrometric (See Hydrometers)**

**HUMIDITY INSTRUMENTS, Hygroscopic**
American Inst. Co.
Barber Colman
Bristol Co.
Foxboro Co.
Friez Instrument
Johnson Service Co.

(Continued)

Powers Regulator
Serdex, Inc.
Taylor Inst. Cos.

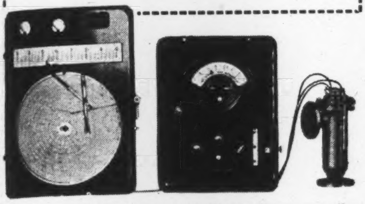
**HUMIDITY INSTRUMENTS, Sling Psychrometric (See Psychrometers, Sling)**

**HUMIDITY, Relative, Indicating Recorders**
Alden Products
American Inst. Co.
Automatic Temp. Control
Bristol Co.
Food Technology, Inc.
Friez Instrument
Gotham Instrument
Green, Henry J.
Leeds & Northrup
Kahl Scientific Inst.
Manning, Maxwell, Moore
Minneapolis-Honeywell
Powers Regulator
Serdex, Inc.
Tagliabue Div.
Taylor Inst. Cos.
Weston Elec. Inst.

**HYDROGEN-ION DETERMINATION INSTRUMENTS**
Aloe Co., A. S.
Bailey Meter Co.
Beckman Instruments
Bristol Co.
Cambridge Inst. Co.
Central Scientific Co.
Coleman Instruments
Connelly, Inc.
Fisher Scientific Co.
Foxboro Co.
Gamma Inst. Co.
General Elec. Co.
Gray Instrument
Hellige, Inc.
Hickok Elec. Inst.
LaMotte Chemical Prod.
Leeds & Northrup Co.
Leitz, Inc.
Macbeth Corp.
Machlett & Son
Minneapolis-Honeywell
Pfaltz & Bauer, Inc.
Photovolt Corp.
Precision Scientific
Rascher & Betzold
Rawson Elec. Inst. Co.
Rubicon Co.
Sargent & Co.
Tagliabue Div.
Taylor & Co., W. A.
Technical Products
Thomas Co., Arthur H.
Thwing-Albert Inst. Co.
Wallace & Tiernan
Welch Scientific
Wilkens-Anderson Co.
Wilson Co.

DEPENDABLE . . .

**BRISTOL**
**pH Recorders**
**and Controllers**



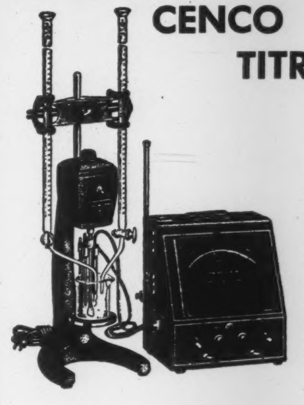
**Bristol pH Recorders and Controllers are instruments of rugged construction and practical design, and have wide use in industrial processes and sewage and waterworks utilities. The control of pH minimizes corrosion difficulties, decreases maintenance costs and eliminates the possibility of contamination of water supplies from plant waste disposal.**

**Bristol pH Equipment consists of the following:**
1. **pH Recorder or Indicator—either type furnished with air-operated or electrically-operated control features—available in the round chart model, shown above, or the strip chart model.**
2. **Beckman pH Amplifier**
3. **Electrode Assembly**

Write for Bulletin pH1302.

**THE BRISTOL COMPANY**
113 BRISTOL RD., WATERBURY 20, CONN.

**CENCO**
**TITRATION-ph**
**TEST UNIT**



is suitable for precise control of neutralizations, oxidation-reduction reactions and precipitations. May be used for electrometric measurement of pH values of aqueous or partly non-aqueous solutions; tests for neutralization value of petroleum products (A.S.T.M. Method D664-49); chemical analysis of inorganic alkaline detergents; tests for industrial wastes; and determining the saponification number of petroleum products (A.S.T.M. Method D939-50)

**The Complete Titration Unit—consists of No. 20945 Titration Stand Assembly; No. 20965A Titration-pH Meter; No. 21106 Glass and 21144 Calomel Electrodes with 30-inch leads; and a set of No. 15938 Paired Burettes.**

The Cenco Titration Unit is suggested in ferrous analyses for arsenic, chromium, copper, manganese, nickel, nitrogen, phosphorous, selenium, sulfur, tin and vanadium. Aluminum may be studied for content of calcium, chromium, copper, iron, magnesium, manganese and tin. Other non-ferrous metals may also be tested.

CENCO

**CENTRAL SCIENTIFIC COMPANY**
*Scientific Instruments • Laboratory Supplies*
1700 Irving Park Road • Chicago 13, Illinois

R.S.C. TULSA
**Refinery Supply Company**
**Tulsa, Oklahoma**

CHICAGO · NEWARK · BOSTON · WASHINGTON
DETROIT · SAN FRANCISCO · SANTA CLARA
LOS ANGELES · TORONTO · MONTREAL
VANCOUVER

**HYDROGENATION APPARATUS**
American Inst. Co.
Central Scientific Co.
Distillation Products, Inc.
Machlett & Son
National Tech. Labs.
Parr Instrument Co.
Podbielniak, Inc.
Precision Scientific

**HYDROMETERS, Indicating**
Ace Glass Inc.
Accuracy Scientific Inst.
Bailey Meter Co.
Fisher Scientific Co.
Fleischhauer & Son
Freas Glass Works
Fried & Lustig
G. M. Mfg. Co., Inc.
Gotham Inst. Co.
Griebel Co.
H-B Inst. Co.
Hiergesell & Sons
Huddleston, J. S. F.
Kahl Scientific Inst.
Kessler Co., Walter H.
Kimble Glass
Mason-Neilan Regulator
Moeller Instrument Co.
Nurnberg Therm. Co.
Phila. Thermometer Co.
Precision Thermometer
Rascher & Betzold
Refinery Supply
Ruehfel Co.
Ruttco Mfg. Co.
Schultheis Corp., E. W.
Scientific Glass Apparatus
Scientific Inst. Co.
Tagliabue Div.
Taylor Inst. Cos.
Testrite Instrument Co.
Trerice Co.
Wagner & Son, Carl H.
Weksler Thermometer

**HYDROMETERS, Mud**
Braun Corp.
Freas Glass Works
H-B Instrument
Hiergesell & Sons
Kessler Co., Walter H.
Moeller Inst. Co.
Wagner & Son

**HYDROMETERS, Recording**
Freas Glass Works
Hiegersell & Sons
Kessler Co., Walter H.
Mason-Neilan Regulator
Norcross Corp.
Precision Thermometer
Rascher & Betzold
Ruehfel Co.

(Continued)

Scientific Inst. Co.
Testrite Instrument Co.
Weksler Thermometer

**HYDROMETERS, Thermo (See Hydrometers, Indicating)**

**HYGROMETERS, Controlling**
American Inst. Co.
Bristol Co.
Ess Instrument
Foxboro Co.
Gordon Co., Claud S.
Gotham Inst. Co.
Green, Henry J.
Minneapolis-Honeywell
Moeller Inst. Co.
Powers Regulator
Scientific Inst. Co.
Serdex, Inc.
Tagliabue Div.
Taylor Inst. Co.
Trerice Co., H. O.

**HYGROMETERS (Hair, etc.) Indicating**
American Inst. Co.
Barber-Colman
Bristol Co.
Cambridge Inst. Co.
Central Scientific Co.
Ever Ready Thermometer
Foxboro Co.
Friez Instruments
Glogau & Co.
G. M. Mfg. Co., Inc.
Green, Henry J.
Griebel Co.
Hiergesell & Sons
Huddleston, J. S. F.
Illinois Testing Labs.
Instruments Corp.
Johnson Service Co.
Kahl Scientific Inst.
Mason-Neilan Regulator
Minneapolis-Honeywell
Moeller Instrument Co.
Palmer Thermometer
Phila. Thermometer Co.
Precision Thermometer
Riecker Inst. Co.
Sargent & Co.
Scientific Inst. Co.
Serdex, Inc.
Standard Thermometer
Tagliabue Div.
Taylor Inst. Cos.
Trerice Co.
Wagner & Son
Wallace & Tiernan
Weksler Thermometer
Wilder Sales Co.

**HYGROMETERS, Recording**
American Inst. Co.
Bristol Co.
Cambridge Inst. Co.
Foxboro Co.
Friez Instrument Div.
General Elec. Co.
Gotham Instrument
Green, Henry J..
Instruments Corp.
Leeds & Northrup Co.
Manning, Maxwell & Moore
Mason-Neilan Regulator
Minneapolis-Honeywell
Moeller Instrument Co.
Palmer Thermometer
Powers Regulator
Scientific Inst. Co.
Seedburo Equip. Co.
Serdex Inc.
Tagliabue Div.
Taylor Inst. Cos.
Trerice Co., H. O.
Weksler Thermometer

**HYGROSTATS**
American Inst. Co.
Barber-Colman Co.
Central Scientific Co.
Friez Instrument Div.
Johnson Service Co.
Powers Regulator Co.
Taylor Instrument Cos.

**HYGRO-THERMOGRAPHS**
Bristol Co.
Central Scientific Co.
Foxboro Co.
Friez Instruments
Green, Henry J.
Instruments Corp.
Manning, Maxwell & Moore
Serdex, Inc.
Taylor Inst. Cos.

**HYPSOMETERS**
Central Scientific Co.
General Elec. Co.
G. M. Mfg. Co.
Kahl Scientific Inst.
Keuffel & Esser Co.
Lufkin Rule Co.
Warren-Knight Co.

**ICE WARNING, Indicators**
Kolsman Inst. Co.
Manning, Maxwell & Moore
Serdex, Inc.

**IGNITION VELOCITY METERS**
Hays Corp.

**ILLUMINATION CONTROLLERS**
Autotron Co.
Betts & Betts
De-Tec-Tronic Labs.
Electronic Lab.
Electronic Prods. Co.
General Electric Co.
General Radio
G-M Labs.
Paragon Electric Co.
Photoswitch, Inc.
Robinette Co.
Rockwell Engr.
Superior Electric
Weston Elec., Inst. Corp.

**ILLUMINATION INDICATORS**
Bradley Laboratories
De-Jur-Amsco Corp.
General Elec. Co.
G-M Labs.
Leeds & Northrup Co.
M B. Mfg. Co.
Meters Inc
Photovolt Corp.
Rockwell Engr.
Triplett Elec. Inst.
Weston Elec. Inst. Corp.

**ILLUMINATION RECORDERS**
Alden Products
Alfax Paper & Eng.
Brush Development
Electro-Tech Equip. Co.
Esterline-Angus Co.
Friez Instruments
General Elec. Co.
Rockwell Engr.

**ILLUMINOMETERS, Macbeth**
Leeds & Northrup

**IMMERSION LIQUIDS for Inspection of Glass & Quartz (Adjusted Indices)**
Cargille, R. P.
Instrument Dev. Labs.
Michrochemical Service
Sheffield Corp.

**IMPACT RECORDERS**
Alden Products
Alfax Paper & Engg.
Analysis Sales Co.
Baldwin Locomotive
Brush Development
Gorrell & Gorrell
Hathaway Inst. Co.
Impact Register
Impact-O-Graph
M. B. Mfg. Co.
Thwing-Albert Inst. Co.

**IMPACT TESTING MACHINES (See Testers & Testing Machine, Impact)**

**INCLINOMETER TUBES**
Fish-Schurman Corp.
Moeller Inst. Co.
Phoenix Prec. Inst.
Precision Thermometer
Ricker Instrument
Trimount Inst. Co.

**INCLINOMETERS,**
Aeromarine Inst. Co.
Eclipse-Pioneer Div.
Ferner Co.
Fischer & Porter
Fish-Schurman Co.
Kollsman Inst. Co.
Machlett & Son
Meriam Instrument
Rieker Inst. Co.
Precision Therm.
Ruehfel Co.
Schwein Engineering
Starrett Co.
Summers Gyroscope
Tejax Eng. Corp.
Trimount Inst. Co.
Warren-Knight Co.

**INCLINOMETERS, Bore Hole**
Sperry-Sun Well Surveying

**INCLINOMETERS, Lateral (Aviation)**
Aeromarine Inst. Co.
Eclipse-Pioneer Div.
Machlett & Son
Rieker Instrument
Schwien Engineering

**INCLINOMETERS, Ship**
Manning, Maxwell & Moore
Moeller Inst. Co.
Negus, T. S. & J. D.
Rieker Instrument

**INDEXES, Base Volume & Base Pressure**
American Meter Co.

**INDICATORS, (Look under the object of measurement and control)**

**INDICATORS, Detonation**
Bliley Elec.
Century Geophysical
Electro Products Labs.
Engineering Res. & Dev.
Photocon Research
Rowe Engineering
Rutishauser Corp.
Sperry Gyroscope
Trimount Inst. Co.

**INDICATORS, DIRECTION (Radioactuated)**
Collins Radio Co.
Eclipse-Pioneer Div.
Electronic Associates
Kollsman Instrument
Lear, Inc.
Polarad Electronics
RCA Div.
Schwien Engg. Co.
Servo Corp. of America
Sperry Gyroscope Co.

**INDICATORS, Engine**
Aero Electronics
Aeromarine Inst. Co.
American Inst. Co.
Bacharach Industrial Inst.
Baldwin-Lima-Hamilton
Cambridge Inst. Co.
Commerical Research
Crosby Steam Gage Co.
Eclipse-Pioneer Div.
Edison Electrical Controls
Electric Tachometer
Electro Products Labs.
Flader Inc., Fredric
Federal Telegraph
General Electric
Hathaway Inst. Co.
Hickok Elec. Inst. Co.
Hobbs Corp.
Kollsmann Inst. Div.
Lewis Engineering
Marsh Corp.
Photocon Research
Rutishauser Corp.
Skaneateles Mfg. Co.
Trimount Inst. Co.

**INDICATORS, Engine Compression**
Aero Electronics
Aeromarine Inst. Co.
Bacharach Industrial Inst.
Baldwin-Lima-Hamilton
Cambridge Inst. Co.
Commercial Research
Electro Products Labs.
Instrument Lab. Inc.
Marsh Corp.
Photocon Research
RCA
Trimount Inst. Co.
Witt Gage Co.

**INDICATORS, Ignition Lag**
American Instrument

**INDICATORS, Multiple Recording**
Alden Products
Alfax Paper & Engg.
Commercial Research
Eclipse-Pioneer Div.
Hays Corp.
Leeds & Northrup
Taylor Instrument Co.
Thwing-Albert Inst. Co.

**INDICATORS, Rate of Climb**
Aeromarine Inst. Co.
Automatic Temp. Control
Eclipse-Pioneer Div.
Kollsman Inst. Div.
Mason-Neilan Co.
Rieker Inst. Co.
Summers Gyroscope

**INDICATORS, Sight Flow**
Bausch & Lomb
King Engr. Corp.
Sarco Co.
Shand and Jurs
Trinity Equipment

**INDICATORS, Sound**
Aircraft Electronics
Amperite Corp.
Audio Tone Oscillator
Clough-Brengle Co.
Daven Co.
Feiler Engineering
General Elec. Co.
General Radio
Kay Electric
Marion Electrical Inst.
Minnesota Electronics
Polarad Electronics
RCA
Reed Research

**INDICATORS, Time Interval see Timers, Automatic, Interval**

**INDUCTANCE METERS**
Aerovox Corp.
Boonton Radio Corp.
Electronic Dev. Lab.
Feiler Engineering
Freed Transformer
General Elec. Co.
General Radio
Industrial Instruments
Leeds & Northrup Co.
Premier Crystal Labs.
Rubicon Co.
Shallcross Mfg. Co.
Sickles Co.

**INSPECTION, Glass & Quartz, (see Immersion Liquids)**

**INSPECTION DEVICES, Optical Projection**
American Optical
Bausch & Lomb
Compar Instrument
Eder Instrument
Engis Equipment
Hillyer Inst.
La Pine & Co., A. S.
Sheffield Corp.
Stocker & Yale
Unertl Optical Co.
Wilder Inc.

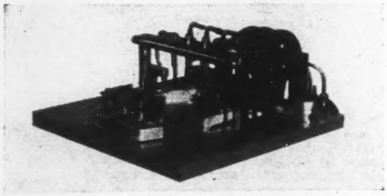
**INSPECTION DEVICES, AUTOMATIC, Color**
Electric Eye Equip.
Gardner Laboratory
Huggins Labs.
Instrument Dev. Labs.

IS PRECISION CLEANING YOUR PROBLEM?

Then the ENG-SOL Method is our answer!

This proven method quickly and effectively cleans electrical contacts, bearings, jet-engine precision parts, and voltage regulators—removes all traces of lapping compounds, oil, fingerprints, lint, or any other surface contamination. Surfaces are made **chemically clean** with a high velocity spray of solvent and air. Compactly built, the ENG-SOL unit takes little more space than an office machine.

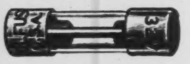
Easy to operate, economical to use, the ENG-SOL method of precision parts cleaning may answer your problem of costly rejects due to improper cleaning. Write for our illustrated booklet, or consult our Research Department for information pertaining to your particular problem.



Unit with cover removed, showing precision part being processed.

PASSAIC ANALYTICAL LABORATORIES, Inc.

228-230 Aycrigg Ave
Passaic 2, N. J.



Instrument fuses designed for high-speed action. For the protection of delicate electrial equipment.

LITTELFUSE, Incorporated

4757 Ravenswood Avenue
Chicago 40, Illinois

**INSPECTION DEVICES, AUTOMATIC, Concentricity**
Autotron Co.
Do-All Co.
Electric Eye Equip.
Federal Prod. Corp.
Martin-Hubbard Corp.
Moore Products
Pratt & Whitney
Sheffield Corp.
Size Control Co.
Swedish Gage Co.

**INSPECTION DEVICES AUTOMATIC, Cylindricality**
Electric Eye Equip.
Federal Products Corp.
Martin-Hubbard Corp.
Moore Products
Photoswitch, Inc.
Pratt & Whitney
Sheffield Corp.
Size Control Co.
Swedish Gage Co.

**INSPECTION DEVICES AUTOMATIC, Diameter**
Berksire Laboratories
DoAll Co.
Electric Eye Equip.
Federal Products Corp.
Gaertner Scientific Corp.
Graham-Mintel Inst.
Martin-Hubbard Corp.
Moore Products
Photoswitch, Inc.
Poole Instruments
Pratt & Whitney
Rowe Engineering
Sheffield Corp.
Size Control Co.
Swedish Gage Co.

**INSPECTION DEVICES, AUTOMATIC, Dimensions**
Aero Electronics
Arma Corp.
Autotron Co.
Berkshire Laboratories
DoAll Co.
Federal Products Corp.
Gaertner Scientific Corp.
Graham-Mintel Inst.
Hillyer Inst.
Martin-Hubbard Corp.
Metron Instrument
Moore Products
Photoswitch, Inc.
Pratt & Whitney
Sheffield Corp.
Size Control Co.
Swedish Gage Co.

**INSPECTION DEVICES, AUTOMATIC, Electrical**
Aero Electronics
Associated Research, Inc.
Berkshire Laboratories
Clarke Inst. Corp.
Clippard Inst. Lab.
Communications Meas. Lab.
Dice Co., J. W.
Do-All Co.
Electric Eye Equip.
Electronic Dev. Lab.
Electro Products Lab.
Feiler Engineering
General Electric
Hillyer Instrument
Industrial Inst. Inc.
Industrial Timer Corp.
Martin-Hubbard Corp.
Nankervis Co., G. L.
Photoswitch, Inc.
Poole Instruments
Size Control Co.
Sperry Products
Thordarson Elec. Mfg.
Wheelco Insts. Co.
Wilmotte, Inc.

**INSPECTION DEVICES, AUTOMATIC, Hardness**
Barber-Colman
Brabender Corp.
Detroit Testing Mach.
General Electric
DoAll Co.
Gogan Machine
Olsen Testing Machine
Rowe Engineering
Swedish Gage Co.

**INSPECTION DEVICES, AUTOMATIC, Insulated Wire**
Berkshire Laboratories
Comtor Co.
Federal Products Corp.

**INSPECTION DEVICES, AUTOMATIC, Smoothness**
Brush Development
Compar Inst. Co.
Comtor Co.
DoAll Co.
Electric Eye Equip.
Electronic Prod. Co.
Federal Products Corp.
General Electric
Photoswitch, Inc.
Physicists Research Co.
Sheffield Corp.
Swedish Gage Co.
Thwing-Albert Inst. Co.

**INSPECTION DEVICES, AUTOMATIC, Thickness**
Aero Electronics
Autotron Co.

(Continued)

Berkshire Laboratories
DoAll Co.
Electric Eye Equip.
Electronic Prod. Co.
Federal Products Corp.
Gaertner Scientific Corp.
General Electric Co.
Hathaway Instrument
Industrial Nucleonics
Instrument Dev. Labs.
Magnaflux Corp.
Magnetic Gauge Co.
Moore Products
Nuclear Inst. & Chem.
Photocon Research
Photoswitch, Inc.
Rowe Engineering
Sheffield Corp.
Thwing-Albert Inst. Co.

**INSPECTION EQUIPMENT, Arc Welding**
General Elec. X-Ray Dept.
Magnaflux Corp.
Rubicon Co.
Van Wagner Co.

**INSPECTION EQUIPMENT, Bore Hole (See Telescopes, Bore, Inspection)**

**INSPECTION EQUIPMENT, Non-Destructive**
Bar-Ray Products
Branson Instruments, Inc.
Dice Co., J. W.
Engineers' Specialties Div.
Federal Products
General Elec. X-Ray Dept.
Gen. Precision Lab.
Genisco Inc.
Industrial Electronics
Kay Electric Co.
La Pine & Co., A. S.
Magnaflux Corp.
Menlo Research Lab.
Physicists Research Co.
Sheffield Corp.
Size Control Co.
Sperry Products
Stocker & Yale
Swedish Gage Co.
Tracerlab
Vacuum Electronic Corp.
Western Radiation Lab.

**INSPECTORS, MAGNETIC**
Aero Electronics
Annis Co.
Commercial Research
Dice Co., J. W.
Fraser Dev. Lab.
General Elec. Co.
Magnaflux Corp.
Magnetic Analysis Corp.
Rowe Engineering
Rubicon Co.
Western Ind. Eng.

**INSPECTORS, WELDING**
Brush Development
Magnaflux Corp.
Rubicon Co.

**INSTRUMENT CLEANING MACHINES**
Aeroil Burner Co.
Bethlehem Apparatus
Eastern Specialty Co.
L & R Mfg. Co.
Marshall Co.
Naxon Utilities
Passaic Anal. Labs.
Philips Mfg. Co.

**INSTRUMENT COVERS**
American Lens Co.
Berkshire Laboratories
Fisher Scientific Co.
General Electric Co.

**INSTRUMENT FUSES (See Fuses, Instrument)**

**INSTRUMENT HOUSINGS (See Housings, Weatherproof, Instrument)**

**INSTRUMENT LUBRICANTS for High and Low Temperature**
Distillation Products
Dow Corning Corp.
Eclipse-Pioneer
Elgin National Watch

**INSTRUMENT OILS**
Daven Co.
Distillation Products
DoAll Co.
Dow Corning
Eastern Specialty
Eclipse-Pioneer Div.
Elgin National Watch
Ferner Co.
Fulcrum Oil Co.
General Elec. Co.
Huisking & Co.
Landis & Gyr. Inc.
Marshall Co.
Mico Inst. Co.
Nye, Inc., William F.
Precision Scientific

**INSTRUMENT REPAIRMEN TOOLS**
Gaunt Industries
Ideal Lab. Tool & Sup.
Johnson Scien. Inst.
Stafford Co.

**INSTRUMENT TRANSFORMERS (See Transformers, Instrument)**

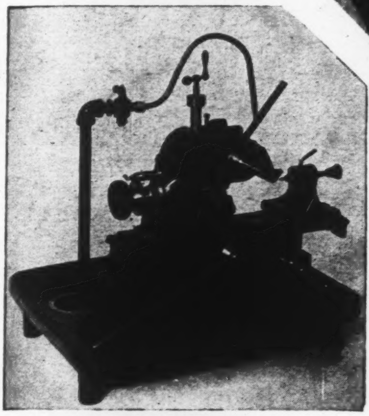
**INSTRUMENT TUBING & FITTINGS**
Crawford Fitting Co.
Imperial Brass Mfg.

(Continued)

Drilling a $\frac{60}{100,000}$-inch diameter hole *(half that of human hair)* on a standard

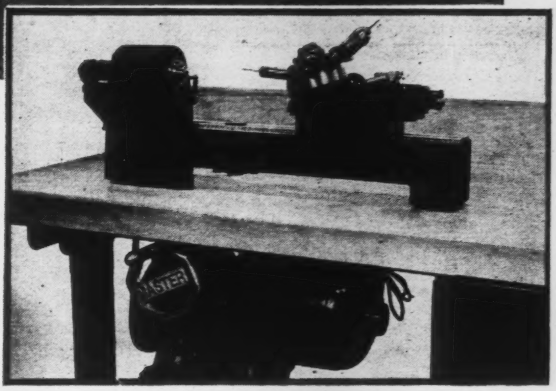
**DERBYSHIRE** *"Elect"* **LATHE**

**As performed at the U. S. Naval Ordnance Laboratory White Oak, Maryland**



**DERBYSHIRE MICROMILL**

Model No. 750 with Ball Bearing Headstock, Cam-operated Vertical Slide, rack and pinion Table Slide, screw-feed Cross Slide, 3/8" diameter Cutter Arbor, Oil Pan, Coolant Pump.

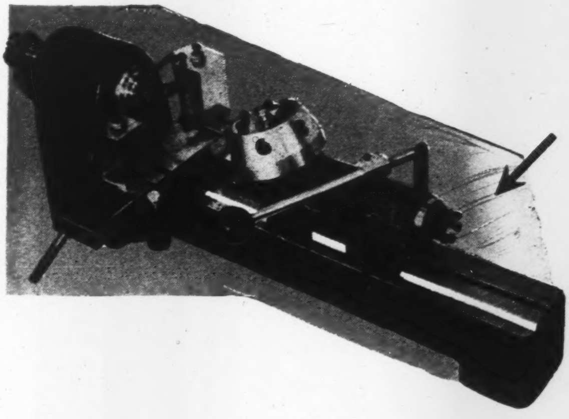


**MODEL NO. 750 PRECISION LATHE**

| | |
|---|---|
| Overall Length | 24" |
| Distance between centers | |
| Length of bed | 22" |
| Swing over bed | .905" |
| Motor | ¼ HP Variable Speed |
| Spindle Speed (Max.) | 18,000 RPM |

Semi-automatic Turret with 5/8" holes

Maximum Collet Capacity—.315" (5/16")



Full details on Derbyshire Precision Lathes are available on request.

**F. W. DERBYSHIRE**

*Incorporated*

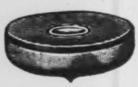
157 HIGH ST., WALTHAM, MASS.

G&B
CIRCULAR
LEVELS

Indicate
in all Directions

No. 12 Mounted 1¼" Base

Unmounted
⅜" To 3"
Diameters



Over 20 Stock Sizes

*Send for Folder*

GEIER & BLUHM, INC.
CIRCULAR LEVELS AND
MECHANICAL DEVICES
Troy, N. Y. U. S. A.

Metal Goods Corp.
Parker Appliance
Precision Tube Co.
Uehling Instrument

**INSULATION TESTING EQUIPMENT (See Testers, Insulation)**

**INSULATORS, THERMOCOUPLE**
Electro-Tech Equipment
Engelhard Inc., Chas.
Leeds & Northrup
Pyrometer Instrument Co.
Richards Co., A. S.
Tagliabue Div.

**INTEGRATORS**
Fischer & Porter
Ford Instrument
Hillyer Instrument
Jacobs Instruments
Kahl Scientific Inst.
Librascope
Stratex Instrument Co.
Summers Gyroscope
Taylor Instrument Cos.
Weston Elec. Instrument

**INTERFEROMETERS**
Acme Industrial
Baird Associates
Bausch & Lomb
Gaertner Scientific Corp.
Jarrel-Ash Co.
Keuffel & Esser Co.
Optron Lab.
Palos Optical Co.
Perkin Elmer Corp.
Zeiss, Inc., Carl

**INVERTERS**
Cornell-Dubilier
Doelcam Corp.
Eclipse-Pioneer
Eicor, Inc.
Gothard Mfg.
Holtzer-Cabot

**IONIZATION CHAMBER For Radioactivity Monitoring**
Applied Physics Corp.
Detectron Co.
Kelley-Koett Inst. Div.
Nuclear Inst. & Chemical
Nucleonic Corp.
Radioactive Products
R-C Scientific Inst.
Special Insts. Lab.
Technical Associates
Tracerlab
Western Radiation Lab.

**JACKS, PLUG-IN (See Connectors, Plugs, Clips)**

**JOB TIMING RECORDERS**
Autocall Co.
Automatic Temp. Control
Bristol Co.
Calculagraph Co.
Cincinnati Time Rec.
Dorothea Mechanisms, Gale
Esterline-Angus Co.
Foxboro Co.
Gorrell & Gorrell
Potter Instrument
Stromberg Electric Co.

**KERR CELLS (See Cells, Kerr)**

**KEYS & SWITCHES**
Alden Products
Applied Science Corp.
Automatic Elec. Chicago
Beck Bros.
Bunnell & Co.
Cinema Engr.
Clare & Co.
Cook Electric
Federal Telephone
Kellogg Switchboard
Leeds & Northrup Co.
Mossman, Inc.
Rubicon Co.
Shallcross Mfg. Co.
Winslow Co.

**KVA INDICATORS**
General Elec. Co.
Leeds & Northrup Co.
Sangamo Electric
Westinghouse Elec.

**KVA RECORDERS**
Esterline-Angus Co.
General Elec. Co.
Landis & Gyr, Inc.
Leeds & Northrup Co.
Sangamo Electric
Westinghouse Elec.

**KYMOGRAPHS**
Associated Research, Inc.
Central Scientific
General Biological
Gorrell & Gorrell
Phipps & Bird
Sargent & Co.
Stoelting Co., C. N.
Thomas Co., Arthur H.
Westinghouse Elec.

**LABORATORY APPARATUS (See Apparatus, Laboratory)**

**LABORATORY FURNITURE (See Furniture, Laboratory)**

**LABORATORY GLASSWARE (See Apparatus, Laboratory, Glass)**

**LABORATORY MOTORS (See Motors, Laboratory)**

**LABORATORY OVENS (See Ovens, Laboratory)**

**LABORATORY PORCELAIN (See Porcelain, Laboratory)**

**LABORATORY SUPPLIES (See Apparatus, Laboratory)**

**LACTOMETERS**
Central Scientific Co.
Freas Glass Works
G. M. Mfg. Co., Inc.
Kahl Scientific Inst.
Kimble Glass
Moeller Instrument Co.
Photovolt Corp.
Precision Thermometer
Rieker Inst. Co.
Ruehfel Co.
Schultheis Corp.
Tagliabue Div.
Taylor Inst. Cos.
Trerice Co.
Welch Scientific

**LAMPS, Pilot (See Pilot Lights)**

**LATHES, INSTRUMENT & ATTACHMENTS**
Ames Precision Machine
**Bayside Watch Tool**
Elgin National Watch
Gallien, R. P.
Koehler Inst. Co.
Levin & Son, Louis
Marshall Co.
Pratt & Whitney
South Bend Lathe

**LEAD SHIELDS**
Bar-Ray Products
Georator Corp.
Kelley-Koett Inst. Div.
MacDonald Co., W. S.
Nuclear Inst. & Chemical
Nucleonic Corp.
Penberthy Instrument Co.
R-C Scientific Inst.
Tracerlab
Western Radiation Lab.

**LEAK INDICATORS, Gas & Water (See Gas Leak Indicators)**

**LENS THICKNESS GAGES**
Bausch & Lomb Optical
Chicago Dial Ind. Co.
Federal Products Corp.
Instrument Dev. Labs.

**LENSES, Astronomical (See Optical Parts)**

**LENSES, Burette (See Optical Parts)**

**LENSES, Low Reflecting Surfaces (See Optical Parts)**

**LENSES, Microscope, etc. (See Optical Parts)**

**LENSES, Polarized (See Optical Parts)**

**LENSES, Thermometer (See Optical Parts)**

**LEVELS, Abney**
Leupold & Stevens

**LEVELS, Dumpy (See Surveying Instruments)**

**LEVELS, Engineer's (See Surveying Instruments)**

**LEVELS, Hand**
Alpha Instrument Co.
Bostrom-Brady
Brunning Co., Inc.
Brunson Instrument
Dietzgen Co.
Ferner Co.
Gurley, W. & L. E.
Keuffel & Esser Co.
Leupold & Stevens
Millers Falls
Pittsburgh Inst. & Mach.
Pratt & Whitney
Republic Lens Co.
Standard Thermometer
Starrett Co.
Stratex Instrument Co.
Suverkop Instruments
United States Blue Print
Warren-Knight Co.
Weber Co., F.
White Co. Inc., David

**LEVELS, Precision**
Alpha Instrument Co.
Berger & Sons
Engis Equipment
Ferner Co.
Fish-Schurman Co.
Glogau & Co.
Gray Instrument
Gurley, W. & L. E.
Heiland Research
Keuffel & Esser Co.
Leupold & Stevens
Moeller Inst. Co.
Republic Lens Co.
Rieker Instrument Co.
Scherr Co., Inc.
Starrett Co.
Warren-Knight Co.
Weber Co., F.
White Co., Inc., David
Zeiss, Inc., Carl

**LEVELS, Prism**
Berger & Sons
Engis Equipment
Fecker, J. W.
Keuffel & Esser Co.
Republic Lens Co.
Taylor Inst. Cos.
White Co. Inc., David

**LEVELS, Spirit**
Boeckler Instrument
Dietzgen Co.
Electronic Products
Engis Equipment
Ferner Co.
Geir & Bluhm, Inc.
Glogau & Co.
Gray Instrument
Gurley, W. & L. E.
Keuffel & Esser Co.
Ruehfel Co.
Warren-Knight Co.
White Co. Inc., David

**LEVELS, Surveying (See Surveying Instruments)**

**LEVELS, Wye (See Surveying Instruments)**

**LIGHT METERS (See Photometers, Illumination)**

**LIGHT SOURCES see also Gas & Vapor Discharge Tubes**

**LIGHT SOURCES, "Daylight"**
American Optical
Atlas Electric Co.
Burton Mfg. Co.
Continental Electric
Electronic Products
Erb & Gray
E & S Optical
General Elec. Co.
Larrimore Sales Co.
**Macbeth Corp.**
Stocker & Yale
Sylvania Elec. Prod.

**LIGHT SOURCES, Incandescent**
American Optical Co.
Bausch & Lomb
Berkshire Laboratories
Burton Manufacturing
Eby, Inc.
Fisher-Pierce Co.
Fredericks, George
Gaertner Scientific Corp.
General Elec. Co.
G-M Labs.
**Larrimore Sales Co.**
Leitz, Inc., E.
Macbeth Corp.
Rockwell Engr. Co.
Stocker & Yale
Sylvania Elec. Prod.

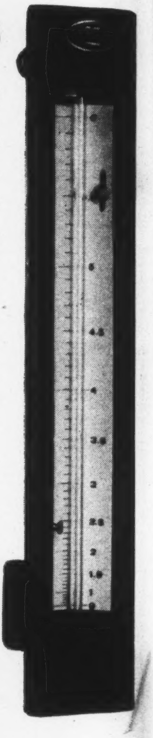
**LIGHT SOURCES, Monochromatic**
Acme Scientific
American Inst. Co.
Amglo Corp.
Baird Associates
Bausch & Lomb Optical
Central Scientific Co.
Dearborn Scientific
DoAll Co.
Ferner Co.
Fish-Schurman Co.
Fuess, Inc.
Gaertner Scientific Corp.
General Elec. Co.
General Physical Lab.
Hanovia Chem. Mfg.
Huggins Labs.
Jarrell-Ash Co.
Laboratory Specialties
Mico Instrument Co.
Optron Laboratory
Pfatz & Bauer, Inc.
Phoenix Prec. Inst.
Polarizing Instrument
Precise Measurements Co.
Rudolph & Sons
Scherr Co., Inc.
Van Keuren Co.

**LIGHT SOURCES, Ultra-Violet**
American Inst. Co.
Atlas Electric Devices
Baird Associates
Burton Mfg.
Central Scientific
Continental Electric
Dietert Co.
Electronic Products
Engineering Res. & Dev.
E & S Optical
Ferner Co.
Fredericks, George
Gaertner Scientific Co.
General Elec. Co.
Hanovia Chem. & Mfg.
Huggins Labs.
Jarrell-Ash Co.
Laboratory Specialties
Leitz, Inc.
Magnaflux Corp.
Menlo Research Lab.
Mico Instrument Co.
Pfaltz & Bauer, Inc.
Phoenix Precision Inst.
Photovolt Corp.
Precise Measurements
Sampson Chem. & Pigment
Stocker & Yale
Sylvania Elec. Prod.
Ultra Violet Products
Westinghouse X-Ray Co.

**LIGHT SOURCES, White Light**
Amglo Corp.
Electronic Products
Fredericks, George
Gaertner Scientific Corp.
General Elec. Co.
**Macbeth Corp.**
Sampson Chem. & Pigment
Stocker & Yale
Sylvania Elec. Prod.
Westinghouse Elec. & Mfg.

Trimount
Manometers

Trimount builds a complete line of accurate high quality instruments including: Well Type, U-tube, Sliding Scale U-tube, Absolute Pressure, Periscope, Inclined, Interchangeable Scale and Service Type Manometers; Tank Level Gauges; Indicating Flow Meter. Suppliers to leading manufacturers. Write for prices and data.



*Send for Catalog*

TRIMOUNT
INSTRUMENT CO.
3119 WEST LAKE ST.
CHICAGO 12, ILLINOIS
Phone: NE 2-3747

**LIGHTHOUSE INSTRUMENTS**
Am. Gas Accumulator
Triumph Mfg. Co.
Wallace-Tiernan

**LIGHT WAVE MEASURING EQUIPMENT**
Acme Scientific Co.
Bausch & Lomb
Dearborn Scientific
DoAll Co.
E & S Optical
Farrand Optical
Gaertner Scientific Corp.
Geophysical Inst. Co.
Optron Laboratory
Sherron Metallic
Van Keuren Co.

**LIGHTS, Pilot (See Pilot Lights)**

**LINE CURRENT TEST SETS (See Testing Sets, Line Current)**

**LINEAR FOOTAGE METERS (See Counters, Footage)**

**LIQUID LEVEL, Indicators & Recorders (See Gages, Liquid Level)**

**LIQUID METERS, INFERENTIAL TYPES (See Flowmeters)**

**LIQUID METERS, POSITIVE TYPES (See Meters, Liquid . . .)**

**LOCATORS, FAULT, Electrical Resistance**
Borden Engineering
Dillon & Co., W. C.
Georator Corp.
Marconi Instruments Ltd.
Tobe Deutschmann

**LOCATORS, Pipe (See Pipe Locators)**

**LOUPES, Eye**
American Optical
**Bausch & Lomb Optical**
Stoelting Co., C. H.
Stratex Instrument Co.
Zeiss, Inc., Carl

**LOUVER OPERATING DEVICES**
Automatic Temp. Control
**Arca Regulators, Inc.**
Bristol Co.
Brown Inst. Div.
Cash Co.
Foxboro Co.
**Friez Instrument**
Friez & Sons
General Controls Co.

(Continued)

Gleason-Avery Inc.
Hagan Corp.
Hathaway Instrument
Mason-Neilan Regulator
Minneapolis-Honeywell
Moore Products
Natural Gas Equipment
Sampsel Time Control
Shallcross Controls

**LUMBER COUNTERS (See Counters, Lumber)**

**LUSTER METERS**
Dearborn Scientific
Leitz Inc.

**MACHINIST'S SQUARES (See Squares, Machinist's)**

**MAGNETIC INSPECTORS (See Inspectors, Magnetic)**

**MAGNETIC OBSERVATORY INSTRUMENTS**
Ruska Inst. Corp.

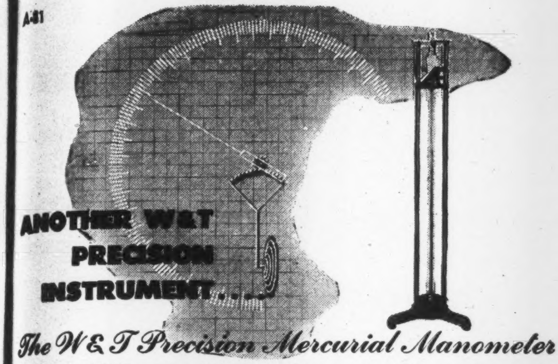
**MAGNETOGRAPHS**
Ruska Inst. Corp.

**MAGNETOMETERS**
Aero Electronics
Associated Research
Baird Associates
Builders Iron Foundry
Cambridge Inst. Co.
Century Geophysical
General Elec. Co.
Geophysical Inst. Co.
Geotechnical Corp.
Heiland Research
Laboratory for Electronics
MacDonald Co., W. S.
Rubicon
Ruska Inst. Corp.
Sprengnether Inst.
Triplett Elec. Inst.
Welch Scientific

**MAGNETOMETERS, Geophysical**
Aero Electronics
Georator Corp.
Gurley, W. & L. E.
Heiland Research
Ruska Inst. Corp.
Sprengnether Inst.

**MAGNETS, Permanent**
Arnold Engineering
Carboloy Dept., GE
Central Scientific Co.
Indiana Steel Products
Ritchie & Son
Thomas & Skinner
Wallace & Tiernan
Westinghouse Elec.

A-81



*The W&T Precision Mercurial Manometer*

The W&T Precision Mercurial Manometer couples maximum precision with ease in handling. These two features have made it a leading instrument in modern research and manufacture for such uses as measuring sample pressures in infrared spectroscopy and calibrating aircraft altimeters. Because of its flexibility and accuracy, the Manometer can be used for almost any type of pressure measuring problem in the range of two atmospheres.

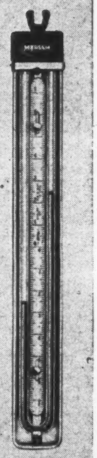
Such characteristics are only part of the picture. Take a look at these additional features:

1. Float type indicator eliminates difficulty in reading meniscus.
2. Adjusting knob provides for temperature compensation over a range of 30° C.
3. Precision bore manometer tube provides accuracy with interchangeability
4. Fixed cistern type manometer requires only one reading.
5. Mercury sealed valve permits evacuating the tube simply and easily at the point of use.
6. Flexible design permits measurement of absolute pressure, gauge pressure, differential pressure, and vacuum.

For more details, write today for free technical bulletin TP-29-A.

**WALLACE & TIERNAN**
**PRODUCTS, INC.**
ELECTRICAL MECHANISMS AND PRECISION INSTRUMENTS
Belleville 9, New Jersey • Represented in Principal Cities

**U-TYPE MANOMETERS**



• These are extremely accurate instruments — representative of Meriam's 30 years of leadership—for measuring pressure, vacuum and differential. The Cleanout type illustrated (patented) available in ranges from 6" to 50" for line pressures up to 100 lbs. per sq. in. permits the body to be disconnected from the head and the tube cleaned without disconnecting the piping. Other types in ranges from 6" to 100" for line pressures up to 400 lbs. per sq. in. Also special designs to meet unusual problems. Fully descriptive catalog sent on request.

**THE MERIAM INSTRUMENT CO.**
10958 MADISON AVENUE
CLEVELAND 2, OHIO

**Manometers, Meters, and Gauges for the accurate measurement of Pressures, Vacuums and Flows of Liquids and Gases.**

**MAGNIFIERS**
American Optical
Bausch & Lomb
Central Scientific
DoAll Co.
Eberbach & Son
E & S Optical
Fish-Schurman Co.
General Biological
General Elec. Co.
Glogau & Co.
G. M. Mfg. Co., Inc.
Howland Optical
Jarrel-Ash Co.
Keuffel & Esser Co.
Kollmorgen Optical Co.
Larrimore Sales Co.
Mann Co., W. I.
Optical Development
Palos Optical Co.
Perkin-Elmer Corp.
Pike & Co., E. W.
Plummer & Kershaw
Scherr Co., Inc.
Speidel & Co.
Stebar Co.
Stratex Instrument Co.
Surty Mfg. Co.
Testrite Instrument Co.
Warren-Knight Co
Weber Co, F.
Zeiss, Inc., Carl

**MALT TESTING APPARATUS** (See Testers, Malt)

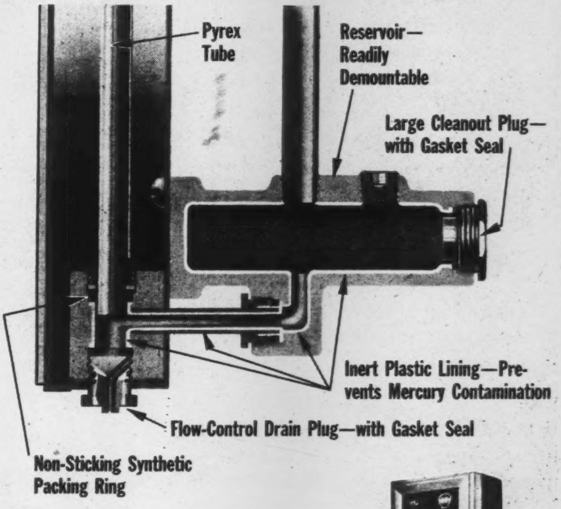
**MANOMETERS, Electric Contact**
Fredericks Co., Geo. E.
H-B Instrument
Magnetrol, Inc.
Precision Thermometer
Refinery Supply Co.
Ruska Inst. Corp.
Shand & Jurs Co.

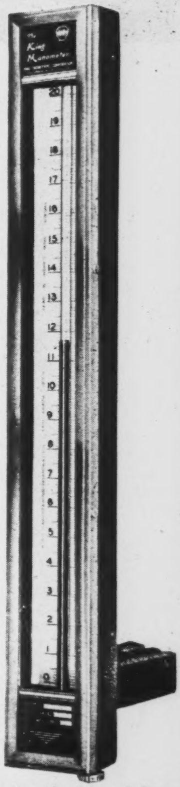
**MANOMETERS, High Pressure**
American Meter Co.
Builders-Providence
Daniel Orifice Fitting
Electronic Products Co.
Foxboro Co.
Hays Corp.
Manning, Maxwell & Moore
Meriam Instrument
Minneapolis-Honeywell
Parks Co., Harry S.
Porter, George K.
Precision Scientific
Precision Thermometer
Refinery Supply
Simplex Valve & Meter
Taylor Inst. Cos.
Thermo Instruments
Trerice Co.

(Continued)

*In Every Field—On Every Service*
**KING MANOMETERS**
*Cut Down-Time and Maintenance!*

**Sectional View Shows Why**


Pyrex Tube
Reservoir—Readily Demountable
Large Cleanout Plug—with Gasket Seal
Inert Plastic Lining—Prevents Mercury Contamination
Flow-Control Drain Plug—with Gasket Seal
Non-Sticking Synthetic Packing Ring



**KING Manometers**
***STAY CLEAN LONGER***

There's ***minimum contamination*** of manometer liquid, because (1) chemically-inert plastic lining prevents contact of liquid with metal parts; (2) no pipe-dope is used below surface of liquid.

**KING Manometers are**
***EASY TO SERVICE***

(1) Reservoir has large cleanout opening for easy removal of dirt and gummy deposits. (2) Reservoir is readily demountable. (3) Special drain plug works like a cock; prevents splashing or spreading of liquid. (4) Synthetic packing ring permits easy removal of glass tube.

**— SPECIFICATIONS —**

**TYPES & SIZES:** Steel, brass, or stainless steel—with low or raised reservoir. 14 sizes, with scales from 12" to 114" long. Can be furnished with glass overflow check valve integral with glass tube.

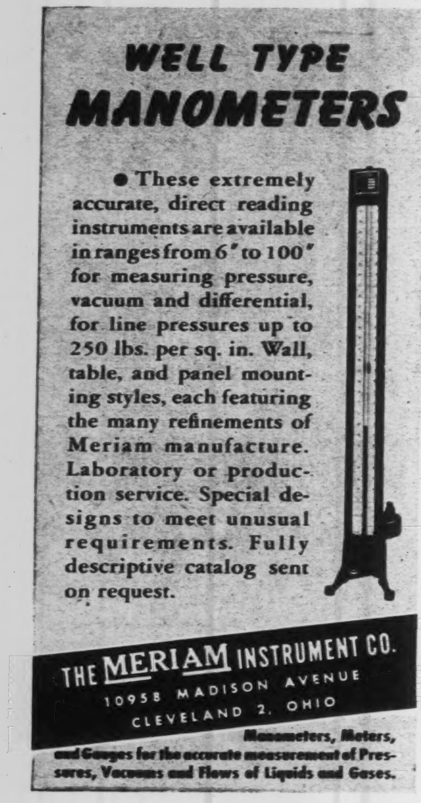
**OPERATING PRESSURES:** Up to 200 psi.

**MOUNTING:** Flush; front of panel; on wall; or on tripod.

***WRITE FOR FULL DETAILS on these and other models.***

**KING ENGINEERING CORP.**
**Detroit Ave. Ann Arbor, Mich.**

King-Gages—Manometers—Self-Closing Push Valves
Sight Feed Bubblers—Glass Tube Check Valves—Air Flow Snubbers—Sediment Traps—D. P. Transmitters


WELL TYPE MANOMETERS

● These extremely accurate, direct reading instruments are available in ranges from 6" to 100" for measuring pressure, vacuum and differential, for line pressures up to 250 lbs. per sq. in. Wall, table, and panel mounting styles, each featuring the many refinements of Meriam manufacture. Laboratory or production service. Special designs to meet unusual requirements. Fully descriptive catalog sent on request.

THE MERIAM INSTRUMENT CO.
10958 MADISON AVENUE
CLEVELAND 2, OHIO

Manometers, Meters, and Gauges for the accurate measurement of Pressures, Vacuums and Flows of Liquids and Gases.

...new CLARKSTAN

MELTING POINT METER

You can quickly and accurately determine the melting points of waxes, resins, gums, fats, tars, plastics, low melting alloys, organic compounds and inorganic compounds. A few milligrams of any of the above substances is all that is required to determine melting points to 500°F. with the Clarkstan Melting Point Meter. A production tool as well as a laboratory instrument—provides instantaneous readings — operates on 110 volts AC or DC. In two models, one to 300°F., the other to 500°F. It's easy to use, easy to read, it's accurate. Price $135.00

Write for data bulletin No. 204 today!

CLARKSTAN CORP.
INDUSTRIAL DIV. II
11921 WEST PICO BOULEVARD
LOS ANGELES 64, CALIFORNIA

Trimount Inst. Co.
Uehling Inst. Co.
Welch Scientific

**MANOMETERS, Inclined Tube**
American Blower Corp.
Bacharach Industrial Inst.
Bailey Meter Co.
Builders-Providence
Defender Inst. & Reg.
Detroit Air Meter Co.
Distillation Products
Dwyer Mfg. Co.
Ellison Draft Gage
Friez Instrument
Hays Corp.
H-B Instrument
Kontes Glass
Manning, Maxwell & Moore
Minneapolis-Honeywell
Meriam Instrument
Moeller Inst. Co.
Parks Co., Harry S.
Precision Scientific
Precision Thermometer
Preferred Utilities
Trimount Inst. Co.
Uehling Inst. Co.

**MANOMETERS, Micro**
Bacharach Industrial Inst.
Cambridge Inst. Co.
Commercial Research
Hathaway Instrument
Kontes Glass Co.
Meriam Instrument
Trimount Instrument
Welch Scientific

**MANOMETERS, Remote-reading**
Bailey Meter Co.
Barton Inst. Co.
Ideal Lab. Tool
Jerguson Gage & Valve
King Engineering
Liquidepth Indicators
Minneapolis-Honeywell
Parks Co., Harry S.
Republic Flow Meters
Thermo Instruments
Trimount Inst. Co.
Uehling Inst. Co.

**MANOMETERS, Single-tube & Reservoir**
Ace Glass Inc.
American Meter Co.
Bacharach Industrial Inst.
Bailey Meter Co.
Barton Inst. Co.
Builders-Providence
Central Scientific
Corning Glass Works
Defender Inst. & Reg.
Dwyer Mfg. Co.
Friez Inst. Div.
Gas Appliance Specialties
Hass Bros. Inst.
Hays Corp.
H & H Thermostats
Ideal Lab. Tool
King Engineering
Kontes Glass Co.
Liquidepth Indicators
Manning, Maxwell & Moore
Meriam Co.
Minneapolis-Honeywell
National Inst. Labs.
Parks Co., Harry S.
Porter, George K.
Precision Therm.
Refinery Supply
Scientific Inst. Co.
Simplex Valve & Meter
Thermo Instruments
Trimount Inst. Co.
Uehling Inst. Co.
Universal X-Ray Prods.
Wallace & Tiernan

**MANOMETERS, U-tube, Electric Transmitting**
Bailey Meter Co.
Bristol Co.
Builders-Providence
Electronic Products Co.
Fielden Instrument
Gorrell & Gorrell
Ideal Lab. Tool
Magnetrol Inc.
Minneapolis-Honeywell
Precision Therm.
Republic Flow Meters
Shand & Jurs Co.
Simplex Valve & Meter
Taylor Inst Cos.
Trerice Co.
Trimount Inst. Co.

**MANOMETERS, U-tube, Glass**
Acme Glass, Inc.
American Inst. Co.
American Meter Co.
Annis Co.
Bacharach Industrial Inst.
Barton Inst. Co.
Bellco Glass Inc.
Bethlehem Apparatus
Builders-Providence
Central Scientific
Continental Equip. Co.
Defender Inst. & Reg.
Distillation Products
Dwyer Mfg. Co.
Electronic Products
Ellison Draft Gage
Fischer & Porter
Fish-Schurman Co.
Fisher Scientific
Fredericks Co., Geo.
Gorrell & Gorrell
Gotham Instrument
Gray Instrument
Hays Corp.
H-B Instrument
Howe & French, Inc.
Ideal Lab. Tool
Kimble Glass Co.
Kontes Glass Co.
Laboratory Equipment Co.
Liquidepth Indicators
Macalaster Bicknell Co.
Machlett & Son
Manning, Maxwell & Moore
Meriam Instrument
Mine Safety Appliances
Moeller Instrument Co.
Phipps & Bird
Podbielniak, Inc.
Precision Scientific
Precision Thermometer
Rascher & Betzold
Refinery Supply Co.
Reiker Instrument
Sargent & Co.
Scientific Inst. Co.
Scientific Glass App.
Shand & Jurs
Simplex Valve & Meter
Specialty Glass Co.
Superior Meter Co.
Tagliabue Div.
Trerice Co.
Trimount Inst.
Uehling Inst. Co.
Uhrig Co., Joseph F.
Universal X-Ray Products
Vapor Recovery Systems
Welch Sciextific
Wilkes-Anderson Co.

**MANOMETERS, U-tube, Metal**
American Meter Co.
Barton Inst. Co.
Bethlehem Apparatus
Cambridge Inst. Co.
Foxboro Co.
Ideal Lab. Tool
Liquidepth Indicators
Manning, Maxwell & Moore
Mason-Neilan Regulator
Parks Co., Harry S.
Precision Scientific
Precision Therm. & Inst.
Scientific Inst. Co.
Taylor Inst. Cos.
Trimount Inst. Co.
Uehling Inst. Co.
Universal X-Ray Prods.

**MAP MAKING PROJECTORS**
Abrams Instrument
Aero Electronics
American Optical
Bausch & Lomb Optical
Thwing-Albert Inst. Co.

**MAP MEASURES**
Aero Electronics
Hand & Sons
Hastings Inst. Co.
LaPine & Co.
Lovins Engr.
Serdex, Inc.
United States Blue Print
White Co., Inc., David

**MARINE INSTRUMENTS (See Nautical Instruments**

**MARINE INSTRUMENTS, Gyro-Compass & Gyro-Pilot, Electro-Mechanical Steering Systems**
Arma Corporation
Doelcam Corp.
Eclipse-Pioneer Div.
Sperry Gyroscope Co.
Summers Gyroscope
U. S. Instrument Corp.
Vectron, Inc.

**MARKERS, Pipe and Wire**
Brady Co., W. H.
Stafford Co.

**MASTER CLOCKS (See Clocks, Master**

**MEASURING MACHINES, Linear**
Adde & Co.
Aero Electronics
American Meas. Insts.
Bausch & Lomb
Bowen & Co.
Counter & Control Corp.
Durant Mfg. Co.
Federal Products Corp.
Ferner Co.
Fidelity Mach. Co.
Gaertner Scientific Corp.
Hillyer Inst.
McDonald Odometer
Lufkin Rule
Olympic Instrument
Potter Instrument
Pratt & Whitney
Production Instrument
Sheffield Corp.
Stocker & Yale
Wilson & Co., G. C.

**MEASURING MACHINES, Wire**
Adde & Co.
Counter & Control Corp.
Durant Mfg. Co.
Federal Products Corp.
Federal Telephone
Ferner Co.
Kellogg Switchboard
Minneapolis Elec.&Const.
Olympic Instrument
Potter Instruments

**MEGOHMMETERS**
Associated Research
Biddle Co., Jas. G.
Cambridge Inst. Co.
Clippard Inst. Lab.
Clough-Brengle Co.
Cole Instrument
Dice Co., J. W.
American Inst. Co.
Am. Paulin System
Electronic Development
Electronic Dev. Lab.
Electro Products Lab.
Electro-Tech Equip.
Feiler Engineering
Freed Tachometer
General Elec. Co.
General Radio Co.
Ill. Testing Labs.
Industrial Instruments
MacLeod & Hanopol
Martindale Electric Co
Measurements Corp.
Meters, Inc.
Precision Apparatus
Radio City Products
Rawson Electrical Inst.
Reiner Eelectronics
Sensitive Research Inst.
Shallcross Mfg. Co.
Sherron Metallic
Southwestern Ind. Elec
Sticht Co.
Triplett Elec. Inst.
Western Radiation Lab.
Westinghouse Elec.
Weston Elec. Inst. Corp.
Winslow Co.

A DWYER DOUBLE FEATURE—

Something New!

1. A FLEXIBLE MANOMETER
Roll it up and
Tuck it away.
Tough Vinyl plastic.
Accuracy in the field.

2. WELL-TYPE WALL MOUNTED
Features:
Over-Pressure safety traps.
Non-Shatter plastic tubing.
Direct reading.
No parallax error.

Write for complete information

F. W. Dwyer Mfg. Co.
333 South Western Avenue Chicago 12, Illinois

**MEGOHM VOLTMETERS (See Voltmeters, Megohm)**

**MELTING POINT APPARATUS**
Ace Glass, Inc.
American Inst. Co.
Central Scientific Co.
Clarkstan Corp.
Corning Glass Works
Ferner Co.
Fisher Scientific Co.
Humboldt Mfg. Co.
Kontes Glass Co.
Machlett & Son
Microchemical Service
National Inst.
Parr Instrument Co
Pfaltz & Bauer, Inc
Precision Scientific Co.
Scientific Glass Apparatus
Tagliabue Div.
Thwing-Albert Inst. Co.

**METAL DETECTORS (See Detectors, Metal**

**METALLIC BELLOWS (See Bellows, Metallic)**

**METALS, Thermostatic**
Acro Switch Div.
Chace Co.
General Plate

**METEORLOGICAL INSTRUMENTS**
Aero Electronics
Cook Electric
Ferner Co.
Friez Inst. Div.
General Elec. Co.
Geophysical Instrument
G. M. Mfg. Co., Inc.
Gorrell & Gorrell
Green, Henry J.
Instruments Corp.
Kahl Scientific Inst.
Moeller Instrument Co.
Precision Therm.
Serdex, Inc.
Stewart, M. C.
Taylor Inst. Cos.
Wallace & Tiernan
Weksler Thermometer
White Co.

**METER LEVELING SADDLES**
American Meter Co.
Commercial Iron Wks.
Robinson Orifice Fitting

**METER PROVERS, Gas**
American Meter Co.
Lambert Meter Co.
Superior Meter Co.

**METER STICKS**
Lufkin Rule Co.
Weber Co.

**METERS, Acid (See Acidimeters)**

**METERS, Ampere Hour (See Ampere Hour Meters)**

**METERS, Batching**
American Instrument
Bowser, Inc.
Brooks Rotameter Co.
Fischer & Porter
Hetherington & Berner
Smith Corp., A. O.

**METERS, Coal (See Coal Meters)**

**METERS, Coin Operated**
American Meter Co.
General Elec. Co.
International Register
Landis & Gyr, Inc.
Rhodes, Inc., M. H.
Superior Meter Co.

**METERS, Compressed Air**
American Meter Co.
Bailey Meter Co.
Builders-Providence
Fischer & Porter
Mason-Neilan Regulator
N. J. Meter
Schutte & Koerting
Simplex Valve & Meter
Taylor Inst. Cos.

**METERS, Condensation**
Bailey Meter Co.
Buffalo Meter Co.
Fischer & Porter
Henszey Co.
Sparling, R. W.
Taylor Inst. Cos.

**METERS, Conductivity (See Conductivity Meters)**

**METERS, Consumer's, Gas**
American Meter Co.
Lambert Meter Co., Inc.
Superior Meter Co.

**METERS, Counting Rate**
Automatic Temp. Control
Berkeley Scientific
Cole Instrument
Douglas Radio Labs.
General Radio
Georator Corp.
Kelley-Koett Inst. Div.
MacDonald Co., W. S.
Nuclear Inst. & Chemical
Nuclear Research & Dev.
Nucleonic Corp.
Radioactive Products
R-C Scientific Inst.
Revere Corp.
Tracerlab
Western Radiation Lab.

**METERS, Current, Air & Gas**
American Meter Co.
Assembly Products
Commercial Research
Fischer & Porter
Kahl Scientific Inst.
Mason-Neilan Regulator
Schutte & Koerting

**METERS, Current, Liquid**
American Meter Co.
Badger Meter Mfg. Co.
Bowser & Co.
Builders-Providence
Commercial Research
Eclipse Aviation
Fischer & Porter
Keuffel & Esser Co.
Leupold & Stevens
Mason-Neilan Regulator
National Meter Co.
Neptune Meter Co.
Northwest Instrument
Schutte & Koerting
Scientific Inst. Co. (Calif.
Sparling, R. W.
Uehling Instrument Co.
Worthington Pump

**METERS, Decibel (See Sound Level Meters)**

**METERS, Demand, Electric**
Associated Research
Automatic Elec. Chicago
Burlington Inst. Co.
Duncan Elec. Mfg.
Electric Indicator Co.
Esterline-Angus Co.
General Elec. Co.
HD Elec. Co.
Landis & Gyr Inc.
Sangamo Electric Co.
Triplett Elec. Inst.
Westinghouse Elec.

**METERS, Demand, Gas**
American Meter Co.
Bailey Meter Co.
Bendix Marine Products
Lambert Meter Co.
Mason-Neilan Regulator
Superior Meter Co.

**METERS, Demand Limiting, Automatic**
American Meter Co.
Annis Co.
Esterline-Angus Co.
General Elec. Co.
Landis & Gyr, Inc.
Mason-Neilan Regulator
Westinghouse Elec.&Mfg.

**METERS, Distortion**
General Radio Co.
Hewlett-Packard
Kay Electric
RCA Div.
Scott, Inc., Hermon

**METERS, Earth Current**
Associated Research
Biddle Co., James G.
Borden Engineering
Cole Instrument
Geophysical Inst. Co.
Heiland Research
Miller, M. C.
Rawson Electrical Inst.
Shallcross Mfg. Co.
Westinghouse Elec.

**METERS, Flow (See Flowmeters)**

**METERS, Fluorescence**
Beckman Instruments
Coleman Electric
Farrand Optical
Menlo Research Lab.
Pfaltz & Bauer
Photovolt Corp.
R-C Scientific Inst.

**METERS, Footage (See Counters, Footage)**

**METERS, Foot-candle (See Foot-candle Meters)**

**METERS, Frequency (See Frequency Meters)**

**METERS, Gas (See Gas Meters)**

**METERS, Gas, Dry Test**
American Meter Co.
Hagan Corp.
Lambert Meter Co.
Republic Flow Meters
Rockwell Mfg.
Superior Meter Co.
Tagliabue Div.

**METERS, Gas, Integrating**
American Meter Co.
Bailey Meter Co.
Bristol Co.
Brown Inst. Div.
Builders-Providence
Fischer & Porter
Foxboro Co.
Hagan Corp.
Lambert Meter Co.
Mason-Neilan Regulator
Penn Ind. Inst. Corp.
Republic Flow Meters
Schutte & Koerting
Superior Meter Co.
Taylor Inst. Cos.

**METERS, Gas, Wet Test**
American Meter Co.
Lambert Meter Co.
Precision Scientific
Superior Meter Co.
Tagliabue Div.
Taylor Inst. Cos.

**METERS, Gas, Station**
American Meter Co.
Bowser & Co.
Smith Corp., A. O.

**METERS, Gasoline (See Meters, Liquid)**

**METERS, High Pressure & High Pressure Distribution**
Barton Instrument
Bristol Co.
Brodie Co., Ralph
Buffalo Meter
Builders-Providence
Foxboro Co.
Hagan Corp.
Hobbs Corp.
Penn Ind. Inst. Corp.
Republic Flow Meters
Revere Corp.
Rockwell Mfg.
Simplex Valve & Meter
Schutte & Koerting
Smith Corp., A. O.
Sprague Meter Co.

**METERS, Hydrogen Ion (See Hydrogen Ion Determination Instruments)**

**METERS, Impedance**
Beckman Insts.
Kay Electric Co.
Lavoie Labs.
Sperry Gyroscope Co.
Technology Instrument

**METERS, LIGHT (See Foot-candle Meters, Illumination Indicators and Recorders, Light Meters, etc.)**

**METERS, Liquid, Volumetric Types, Nutating Piston or Disk**
Askania Regulator Co.
Badger Meter Co.
Bowser, Inc.
Brodie Co.
Buffalo Meter Co.
Hays Corp.
Neptune Meter Co.
Rockwell Mfg.
Worthington Pump

**METERS, Liquid Volumetric Types, Oscillating Piston**
Badger Meter Co.
Brodie Co., Inc.
Neptune Meter Co.
Rockwell Mfg. Co.

**METERS, Liquid, Volumetric Types, Propeller**
Badger Meter Mfg. Co.
Builders-Providence
Henszey Co.
Rockwell Mfg.
Sparling, R. W.

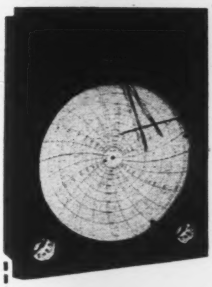
**METERS, Liquid, Volumetric Types, Reciprocating Piston**
Askania Regulator Co.
Bowser Inc.
Brodie Co.
Rockwell Mfg.
Ruska Inst. Corp.

**METERS, Liquid, Volumetric, Rotary Piston**
Askania Regulator Co.
Badger Meter Co.
Bowser, Inc.
Brodie Co.
Revere Corp.
Rockwell Mfg.
Smith Meter Co.

**METERS, Liquid, Volumetric, Special for Extremely Low Flow**
Askania Regulator Co.
Bowser Inc.
Brooks Rotameter
Commercial Research
Fischer & Porter
Hays Corp.
Neptune Meter Co.
Schutte & Koerting
Yellow Springs Inst.

**METERS, Liquid, Weighing**
Bowser, Inc.
Commercial Research
Engineering Res. & Dev.
Richardson Scale Co.
Uehling Instrument

**METERS, Mileage**
Eclipse-Pioneer Div.
Engineering Res. & Dev.
Jaeger Watch Co.
Knopf Instrument
Ohmer Register
Sangamo Electric Co.
Speedometer Electric
U. S. Taximeter
Veeder-Root, Inc.



Flow and Liquid Level Meters—Mechanical

- For measuring, controlling, integrating flow of water, steam, air, oil, gas and other fluids. Recorders with either square root or evenly divided charts. Interchangeable range tubes provide for changing meter capacity without change of orifice.

Brown Pneumatic Transmission Type Flow Meters for hazardous locations and for remote readings.

Also Brown Differential Converter, a pneumatic balance flow transmitter, contains no mercury or seals; has wide rangeability. Send for Catalogs 2221, 2022, and 2281.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4579 Wayne Ave., Philadelphia 44, Pa.

MINNEAPOLIS Honeywell
Brown Instruments

**METERS, Oil (See Meters, Liquid)**

**METERS, Orifice (See Flowmeters, Orifice)**

**METERS, Oxygen (See 1—Gas Analyzer; 2—Gas Meters)**

**METERS, Phase Angle (See Phase-Angle Meters)**

**METERS, Pitot Tube (See Flowmeters, Pitot Tube)**

**METERS, Positive Displacement (See Gas Meters, Positive and Liquid Meters, Volumetric)**

**METERS, Prepayment**
American Meter Co.
General Electric Co.
Landis & Gyr, Inc.
Sangamo Electric Co.

**METERS, Proportional**
American Meter Co.
Bailey Meter Co.
Bristol Co.
Fischer & Porter
Foxboro Co.
Mason-Neilan Regulator

(Continued)

Minneapolis-Honeywell
Mittelman Electronics
Proportioneers, Inc.
Republic Flow Meters
Schutte & Koerting
Taylor Inst. Cos.

**METERS, Reactive Component**
Boonton Radio Corp.
Cole Instrument
Esterline-Angus Co.
General Elec. Co.
Landis & Gyr Inc.
RCA Manufacturing
Sangamo Electric
Triplett Elec. Inst.
Westinghouse Elec.
Weston Electrical Inst.

**METERS, Rotary Displacement**
Askania Regulator Co.
Bowser Inc.
Brodie Co.
Henszey Co.
Revere Corp.
Smith Corp., A. O.

**METERS, Sewage**
American Meter Co.
Bailey Meter Co.
Bristol Co.

(Continued)

Builders-Providence
Hagan Corp.
Hays Corp.
Leupold & Stevens
Mason-Neilan Regulator
Republic Flow Meters
Rockwell Mfg.
Simplex Valve & Meter
Taylor Inst. Cos.

**METERS, Shunt**
Builders-Providence
Burlington Inst. Co.
Cole Instrument
Columbia Elec. Mfg.
Dale Instruments
Daven Co.
Electronic Development
Fischer & Porter
Instrument Resistors
Radio City Products
Rawson Electrical Inst.
Reiner Electronics
Sangamo Electric
Shallcross Mfg.
Wheelco Inst. Co.
Westinghouse Elec.

**METERS, Sight Flow**
Bowser Inc.
Brooks Rotameter Co.
Commercial Research

(Continued)

Fischer & Porter Co.
Henszey Co.
Schutte & Koerting
Selas Co.

**METERS, Station**
American Meter Co.
Bristol Co.

**METERS, Steam (See Flowmeters, Steam)**

**METERS, Time**
Aero Instrument Co.
Alina Corp.
Amer. Chronoscope
Berkeley Scientific
Betts & Betts
Boeckeler Instrument
Bristol Co.
Cramer Co., Inc.
Cyclotron Specialties
Elec. Tachometer Corp.
General Elec. Co.
Gorrell & Gorrell
Haydon Co.
Industrial Timer Corp.
Jaeger Watch Co.
J-B-T Instruments
Marion Electrical Inst.
National Instrument Co.
Paragon Electric Co.

(Continued)

NIAGARA METERS

Single nutating piston volumetric displacement type, with integrating registers.

*For most liquids including:*

- COLD WATER
- OILS
- HOT WATER
- SOLVENTS
- CHEMICALS
- SYRUPS

BUFFALO METER CO.
2906 Main St., Buffalo, N. Y.

BAILEY
Fluid Meters
For STEAM · LIQUIDS · GASES

● Bailey Fluid Meters are designed to indicate, record and integrate the flow of steam, liquids, or gases under practically any pressure or temperature condition.

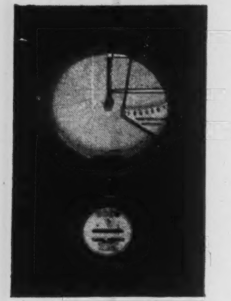
A great variety of indicating, recording and integrating combinations are available for use with four distinct types of flow mechanisms.

This large variety of possible combinations enables the flow meter engineer to specify equipment which is pre-eminently suited to any flow measuring application.

When it is desired to place indicators, recorders and integrators at a considerable distance from the primary element, Bailey Synchro-Meters are available to provide electric transmission.

For detailed information consult Sweet's Engineering Catalogs or request a copy of bulletin No. 301.

BAILEY METER COMPANY
1041 IVANHOE ROAD · CLEVELAND, O.
Bailey Meter Company, Ltd. Montreal, Canada



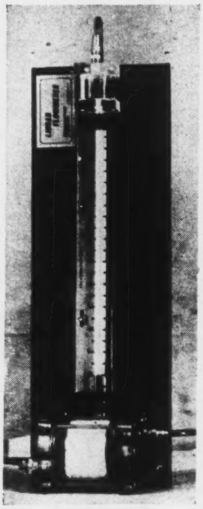
REPUBLIC FLOW METERS

Republic electrical type flow meters are available for measuring the flow of all types of liquids and gases. Meter bodies are built for metering fluids at line pressures up to 10,000 lb. per sq. in. and for all ranges of differential pressure. The reading instruments — indicator, recorder and integrator—are of the remote reading type and can be located any distance from the point of flow measurement.

WRITE FOR DATA BOOK 702

REPUBLIC FLOW METERS CO.
2240 Diversey Pkwy. Chicago 47, Ill.

REPUBLIC
INSTRUMENTS • CONTROLS



PRECISION FLOWMETERS are but one of our line of high precision pneumatic instruments.

Also available:

Standard flow orifices
Liquid manometers
Remote reading flowmeters
High pressure flowmeters
Flowmeter calibrations

NATIONAL INSTRUMENT LABORATORIES
4001 38th St., Brentwood, Md.

FLOW METERS

• The Type H illustrated is an extremely accurate indicating instrument for measuring the flows of gases or liquids when operating pressures do not exceed 250 lbs. per sq. in. and the differential pressure does not exceed 160 inches of water pressure. Wall or Panel Mounting. Direct reading scales to meet any requirement. Also Inclined Tube types—for low differential ranges of 25" or 49" of water. Fully descriptive catalog sent on request.

THE MERIAM INSTRUMENT CO.
10958 MADISON AVENUE
CLEVELAND 2, OHIO

Manometers, Meters, and Gauges for the accurate measurement of Pressures, Vacuums and Flows of Liquids and Gases.

Phillips Petroleum
Potter Instrument
Production Instrument
Rawson Electric Co.
Rhodes, Inc., M. H.
Rowe Engineering
Standard Elec. Time
Thompson Clock Co.
Walkirt Co.
Waltham Watch
Warren Telechron Co.
Westinghouse Elec.
Weston Elec. Inst. Corp.

**METERS, Ultraviolet Radiation**
Beckman Instruments
Farrand Optical
General Elec. Co.
Nuclear Inst. & Chem.
Pfaltz & Bauer
Photovolt Corp.
Westinghouse Elec.

**METERS, Venturi (See Flowmeters, Venturi)**

**METERS, V-notch (See Flowmeters, Weir)**

**METERS, Volumetric, Positive Displacement (See Gas Meters, Positive; see Meters, Liquid, Volumetric)**

**METERS, Water (See Liquid Meters, Volumetric; also Flowmeters, Liquid)**

**METERS, Watt-Hour**
Associated Research
Duncan Electric
General Elec. Co.
Landis & Gyr, Inc.
Roller-Smith
Sangamo Electric Co.
Sticht Co.
Veeder-Root
Westinghouse Elec.

**METERS, Weir (See Flowmeters, Weir)**

**METERS, X-Ray Intensity**
General Electric X-Ray
Georator Corp.
Marconi Instruments Ltd.
Nucleonic Corp.
Radiation Counter Labs.
R-C Scientific Inst.
Sensitive Research
Special Instruments Lab.
Western Radiation Lab.

**MICROAMMETERS (See Ammeters, Microammeters)**

**MICHROCHEMICAL LABORATORY APPARATUS**
Baker & Company
G. M. Manufacturing Co.
Kauffman-Lattimer
Laboratory Equipment
La Pine & Co., A. S.
Microchemical Service
Micro-Metric Inst.
Parr Instrument
Radiation Counter Labs.
Uhrig Co., J. F.

**MICRODENSITOMETERS (See Densitometers)**

**MICROFARADMETERS**
Biddle Co., Jas. G.
Clippard Inst. Lab.
Clough-Brengle Co.
Feiler Engineering
Hickok Elect. Inst.
Triplett Elec. Inst.
Westberg Mfg. Co.
Weston Elec. Inst.

**MICRO-MANIPULATORS**
Bausch & Lomb
Bidwell Instrument
Gamma Inst. Co.
Industrial Instruments
Mico Instrument Co.
Process & Instruments
Zeiss, Inc., Carl

**MICROMANOMETERS (See Manometers, Micro)**

**MICROMETERS, Calendar**
Precision Thermometer
Size Control Co.

**MICROMETERS, Dial**
Alina Corp.
Ames Co., B. C.
Amthor Test. Mach.
Cady & Co., E. J.
Exact Weight Scale
Federal Products Corp.
Ferner Co.
Gen. Engg. & Model Wks.
Glogau & Co.
Marshall Co.
Micro Master Co.
Park Sales
Scherr Co., Inc.
Size Control Co.
Starrett Co.

**MICROMETERS, Electronic**
Aero Electronics
Dice Co., J. W.
DoAll Co.
Electric Eye Equip.
Electro Products Labs.
Federal Products Corp.
**Graham-Mintel Inst.**
Hathaway Inst. Co.

(Continued)

Hickok Elec. Inst.
Photoswitch, Inc.
Poole Instruments
Rockwell Engr.
Schaevitz Engg.
Sherron Metallic
Stevens-Arnold, Inc.
**Wilmotte, Inc.**

**MICROMETERS, External**
Brown & Sharpe
Elgin National Watch
Lufkin Rule
Marshall Co.
Maveg Machine Sales
Millers Falls
Park Sales
Poole Instruments
Pratt & Whitney
Rimat Machine
Scherr Co., Inc.
Size Control Div.
Slocomb Co., T. J.
Starrett Co.
Swedish Gage

**MICROMETERS, Filar Eyepiece**
American Optical Co.
Bausch & Lomb
Fecker, Inc.
Ferner Co.
Gaertner Scientific Corp.
Jarrell-Ash Co.

**MICROMETER, Flying**
Magnetic Gauge Co.

**MICROMETER, Internal**
Brown & Sharpe
Lufkin Rule Co.
Maveg Machine Sales
Micro Products Co.
Millers Falls Co.
Poole Instruments
Rimat Machine
Scherr Co., Inc.
Slocomb Co., J. T.
Starrett Co.
Swedish Gage
Zeiss, Inc., Carl

**MICROMETERS, Optical**
American Optical
Bausch & Lomb
Engis Equipment
Fecker, Inc.
Fish-Schurman Co.
Gaertner Scientific Corp.
Instrument Dev. Labs.
Jarrell-Ash Co.
Keuffel & Esser Co.
Leitz, Inc.
Mann Co., W. I.
Mogey & Sons
Palos Optical Co.
Scherr Co., Inc.
Stocker & Yale
Unertl Optical Co.
Zeiss Inc., Carl

**MICROMETERS, Pedestal**
Bartelt Engg. Co.
Swedish Gage Co.

**MICROMETERS, Radio**
Electro Products Labs.
Hastings Inst. Co.
Panoramic Radio Co.
Sensitive Research Inst.

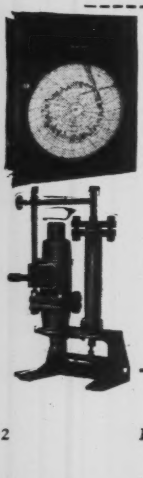
**MICROPHONES**
Amperite Co.
Audio Instrument
Automatic Elec. Chicago
Brush Development
Eby Inc., Hugh
Electro-Voice Mfg.
Globe Phone Mfg. Co.
Gulton Mfg.
Kellogg Switchboard
Leich Electric
Massa Laboratories
Rauland-Borg Corp.
RCA Div.

**MICROPROJECTOR**
American Meas. Insts.
Bausch & Lomb
Ferner Co.
General Biological
International Micro
Jones & Lamson Mach.
Leitz, Inc.
Mine Safety Appliances
Pfaltz & Bauer
Scherr Co., Inc.
Stocker & Yale
Wilder, Inc.

**MICROSCOPE ACCESSORY INSTRUMENTS**
American Optical
Bausch & Lomb Optical
Bidwell Instrument
Burton Mfg. Co.
Erb & Gray
Ferner Co.
Gaertner Scientific Corp.
General Biological
International Micro
Leitz, Inc.
Lovins Engr.
Microchemical Service
Zeiss, Inc., Carl

**MICROSCOPE ILLUMINATORS**
American Optical
Bausch & Lomb Optical
Boehmke Optical Co.
Burton Mfg. Co.
Central Scientific Co.
Clarkstan Corp.
Erb & Gray
Ferner Co.
Gaertner Scientific Corp.
General Biological
General Elec. Co.

(Continued)



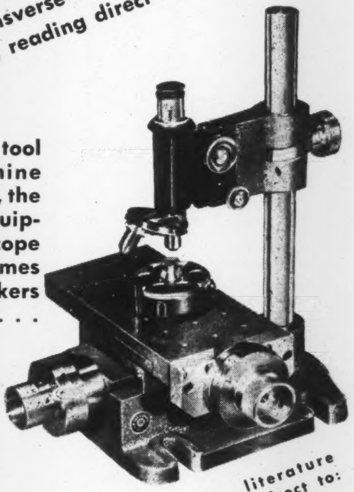
Flow and Liquid Level Meters—Electric

• For recording, indicating, controlling and totalizing flow of fluids. Unsurpassed for power plant applications where accurate results are paramount and where instrument is at a remote location from point of measurement. Recorders available with either square root or evenly divided charts.

A variety of meter bodies available for handling from 2 to 10,000 lbs. line pressure. Also Brown Area Meter body for metering viscous fluids, hot tar, Bunker "C" oil, etc. Send for Catalog 2221 and 2022.

MINNEAPOLIS-HONEYWELL REGULATOR Co., *Industrial Division*, 4579 Wayne Ave., Philadelphia 44, Pa.

MINNEAPOLIS
Honeywell
Brown Instruments



job-tailored...

E & G COMPOUND BASE

the only work-table offering 6" lateral and 4" transverse continuous micrometer motion, reading direct to 1/10,000"

a highly versatile tool for precision machine work and inspection, the Compound Base equipped with the microscope of your choice becomes a complete Toolmakers Microscope . . . . . . . .

mechanically unsurpassed and optically job-tailored to your particular needs!

for literature write direct to:

ERB & GRAY

854 So. Figueroa St., Los Angeles 17

Made in U. S. Zone of Germany

ZEISS OPTON

STEREO-MICROSCOPE

6x to 80x with Unique Mechanism for Quickly Changing Magnification.

For All Magnifications Free Working Distance of 3¾" Remains Constant Due To New Type Objective.

*Write for Literature*

CARL ZEISS, INC.
485 Fifth Avenue
New York 17, N. Y.

*Guaranteed Uninterrupted Repair Service*

International Micro
Leitz, Inc.
Lindly & Co.
Microchemical Service
Optical Service & Dev.
Pfaltz & Bauer, Inc.
Precision Scientific
Stocker & Yale
Zeiss, Inc., Carl

**MICROSCOPES, Ballistic, Comparison**
Bausch & Lomb Optical
Ferner Co.
Jarrell-Ash Co.
Leitz, Inc.
Zeiss, Inc.

**MICROSCOPES, Binocular**
American Optical
Bausch & Lomb Optical
Boehmke Optical Co.
Federal Mfg. & Eng.
Ferner Co.
General Biological
International Micro
Jarrell-Ash Co.
Leitz, Inc.
Lovins Engr.
Polarizing Instrument
Scherr Co., Inc.
Zeiss, Inc., Carl

**MICROSCOPES, Biological (See Microscopes, Binocular)**

**MICROSCOPES, Brinell**
Bausch & Lomb Optical
Boeckeler Instrument
Detroit Testing Mach.
Ferner Co.
Fisher Scientific Co.
Gaertner Scientific Corp.
Gordon Co.
Leitz, Inc.
Olsen Testing Machine
Pittsburgh Inst. & Mach.
Riehle Division
Steel City Testing Mach.

**MICROSCOPES, Dark Field**
Aloe Co., A. S.
American Optical
Bausch & Lomb Optical
Ferner Co.
International Micro
Polarizing Instrument

**MICROSCOPES, Electron**
Farrand Optical
General Electric Co.
North American Philips
RCA Div.

**MICROSCOPES, Finish Comparison**
American Optical
Bausch & Lomb Optical
Compar Instruments

(Continued)

Engineers Specialty Div.
Engis Equipment
Fecker, J. W.
Ferner Co.
Gaertner Scientific Corp.
Instrument Dev. Lab.
Leitz, Inc.
Optical Development Corp.
Pike & Co., E. W.
Scherr Co., Inc.
Stratex Instrument Co.
Zeiss, Inc., Carl

**MICROSCOPES, Inspection (See Microscopes, Finish Comparison)**

**MICROSCOPES, Measuring**
American Optical
Bausch & Lomb Optical
Central Scientific Co.
Clarkstan Corp.
Dome Precision
Engis Equipment
Fecker, J. W.
Ferner Co.
Gaertner Scientific Corp.
Griswold Mfg. Co.
Instrument Dev. Lab.
Jarrell-Ash Co.
Leitz, Inc.
Maveg Machine Sales
Mico Instrument Co.
Palos Optical Co.
Scherr Co., Inc.
Stebar Co.
Wilder, R. S.
Zeiss, Inc., Carl

**MICROSCOPES, Metallographic**
Abrams Instrument
American Optical
Bausch & Lomb
Ferner Co.
Gamma Inst. Co.
General Biological
Leitz, Inc.
Lovins Engr.
Mico Instrument Co.
Optical Service & Dev.
Pfaltz & Bauer, Inc.
Scherr Co., Inc.
Stocker & Yale
Zeiss, Inc., Carl

**MICROSCOPES, Petrographical**
American Optical
Bausch & Lomb Optical
Ferner Co.
Leitz, Inc.
Polarizing Instrument
Zeiss, Inc., Carl

**MICROSCOPES, Thread Contour (See Microscopes, Finish Comparison)**

**MICROSCOPES, Toolmaker's**
Alina Corp.
American Meas. Insts.
Bausch & Lomb Optical
Boeckeler Instrument
Clarkstan Corp.
Dome Precision
Engis Equipment
Ferner Co.
Gaertner Scientific Corp.
Goerz Amer. Optical
Leitz, Inc.
Maveg Machine Sales
Mico Instrument Co.
Pfaltz & Bauer
Scherr Co., Inc.
Stratex Instrument Co.
Zeiss, Inc., Carl
Zenith Optical Co.

**MICROSCOPES, Wire Gaging**
Bausch & Lomb Optical
Clarkstan Corp.
Ferner Co.
Zeiss, Inc., Carl

**MICROTOMES**
American Optical
Baldwin Locomotive
Bausch & Lomb Optical
Cambridge Inst. Co.
Central Scientific Co.
Ferner Co.
International Equip. Co.
Jarrell-Ash Co.
Leitz, Inc.
Lovins Engr.
Mico Instrument Co.
Thomas Co., Arthur H.

**MICROVOLTMETERS (See Voltmeters, Micro)**

**MILEAGE METERS (See Meters, Mileage)**

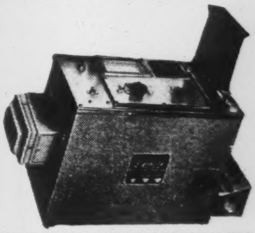
**MILK TESTERS (See Testers, Milk)**

**MILLIAMMETERS (See Ammeters, Milliammeters**

**MILLIOHMMETERS (See Voltmeters, Millivoltmeters)**

**MILLIVOLTMETERS (See Voltmeters, Millivoltmeters)**

**MINE GAS INDICATORS (See Detectors, Mine Gases)**



Moisture a Problem
*in your production, storage, shipping, buying and selling?*

Save grain, popcorn, nuts, hundreds of other products that mildew and rot when moisture is not controlled. Speed and control production of dehydrated vegetables, powdered eggs, cocoa, gun powder.

*TO CONTROL—YOU MUST KNOW THE MOISTURE CONTENT*

Over 18,000 laboratories, mills, elevators, manufacturers, now TEST MOISTURE ACCURACY IN ONE MINUTE with Seedboro's Steinlite New Model 400G Moisture Tester. Other use the Steinlite (5 minute) Liquid Cell to determine maturity and control processing of fresh fruits, vegetables.

*Save spoilage and speed production. Learn more about the simple, faster Steinlite Moisture Tester.*

MAIL THE COUPON!

SEEDBURO

Seedburo Equipment Co.
618 Converse Bldg., Chicago 6, Ill.

I ☐process, ☐manufacture, ☐store, ☐buy, ☐sell ..........

Please tell how your Steinlite may help me reduce spoilage or speed production.

Firm name ..........
Address ..........
City .......... State ..........

POWER
FLEXO-ACTION
UNDER CONTROL

FLEXO-ACTION

GEARED MOTORS

INDUCTION
SYNCHRONOUS
SERIES
SHUNT
REVERSING

ANY SPEED
ANY DRIVE
ANY CURRENT
TORQUES TO
150 POUND INCH

FOR FINE INSTRUMENTS

Dependable drives for charts, tapes, pens, valves, controls, etc.
*Prompt delivery.* Send for details

MERKLE-KORFF GEAR CO.
214 N. MORGAN ST. CHICAGO 7, ILL.

*"The Best Book of its kind—not only on Glass Blowing but on hundreds of techniques"*

Scientific and Industrial Glass Blowing and Laboratory Techniques

By

WILLIAM E. BARR and VICTOR J. ANHORN
*Gulf Research and Development Co.*

This book appeared in serial form in *Instruments* from December 1945 to November 1947 (both inclusive) and was hailed in many laboratories and plants as "the last word on a hundred and one useful subjects."

*Skilled Technician Barr and Scientist Dr. Anhorn have jointly written the MOST INFORMATIVE book on glass blowing ever prepared.*

Not only is construction explained in detail, but the operating principles of all pieces of apparatus are also explained.

380 PAGES

212 FIGURES, most consisting of several diagrams, total over 300.

24 TABLES. EXPERTLY-COMPILED INDEX.

$ 6.00 postpaid

Remittance must accompany order

INSTRUMENTS PUBLISHING CO.
921 Ridge Ave., Pittsburgh 12, Pa.

**MIRRORS**
Acme Industrial
American Lens
Bache, Semon
Bausch & Lomb Optical
Boehmke Optical Co.
Bray Optical
Cal-Astro Optical Labs.
Century Geophysical
Clark & Sons
Curtiss Labs.
Dearborn Scientific
Dome Precision
Fecker, Inc.
Fish-Schurman Co.
Gaertner Scientific
Geophysical Inst. Co.
Glendale Optical
Gurley, W. & L. E.
Hathaway Inst. Co.
Hayward Scientific Glass
Henson Co., Fred C.
Herron Optical
Housten Technical Lab.
Ice Optical Co., H. C.
International Glass
Keuffel & Esser Co.
Kollmorgen Optical Co.
Laboratory Specialties
Lancaster Lens Co.
Mann Co., W. I.
National Research
Pacific Optical
Pacific Univ. Prod.
Palos Optical Co.
Penn Optical & Inst.
Perkin-Elmer Corp.
Pioneer Instrument
Process & Instruments
Rieker Inst. Co.
Robinson Optical Co.
Simpson Optical Mfg.
Tinsley Labs.
Unertl Optical Co.
Univis Lens Co.
Warren-Knight Co.
Zenith Optical

**MODULATION METERS**
Electronic Div. Lab.
General Electric
General Radio Co.
Marion Electrical Meter
Panoramic Radio Co.
RCA Div.
Sylvania Elec. Prod.
Weston Elec. Inst. Corp.

**MOISTURE METERS (See also Testers, Moisture)**
Alpha-Lux Co.
Brabender Corp.
Delmhorst, William
Dietert Co.
Electronic Products Co.
Ferner Co.
General Elec. Co.
Hart Moisture Gage
H & H Thermostats
Measurements Corp.
Moisture Register Co.
Precision Scientific
Seedburo Equip. Co.
Serdex, Inc.
Sherron Metallic
Tagliabue Div.

**MOISTURE TESTING APPARATUS (See Testers, Moisture)**

**MOLECULAR STILLS**
Distillation Prod., Inc.

**MONOCHROMATIC LIGHT SOURCES (See Light Sources, Monochromatic)**

**MONOCHROMATORS**
Baird Associates
Bausch & Lomb Optical
Biddle Co., James G.
Farrand Optical
Ferner Co.
Gaertner Scientific Corp.
General Elec. X-Ray Dept.
Instrument Dev. Labs.
Jarrell-Ash Co.
Leitz, Inc.
National Tech. Labs.
Rudolph & Sons
Zeiss, Inc., Carl

**MONOCHROMETERS, Infrared**
Gaertner Scientific
Kauffman-Lattimer
Perkin-Elmer Corp.

**MOTION INDICATORS**
Aero Electronics
Automatic Temp. Control
Bristol Co.
Brush Development
Builders-Providence
Century Geophysical
Elec. Tachometer Corp.
Foxboro Co.
Genisco Inc.
Knopf Instrument
Martin-Hubbard Corp.
Mason-Neilan Reg. Corp.
Photoswitch, Inc.
RCA Manufacturing
Republic Flow Meters
Servo-Tek Products

**MOTION RECORDERS**
Annis Co.
Atomic Instrument
Automatic Elec. Chicago
Bristol Co.
Brush Development
Builders-Providence
Elec. Tachometer Corp.
Esterline-Angus Co.
Foxboro Co.
Gorrell & Gorrell
Impact Register
Martin-Hubbard Corp.
Mason-Neilan Reg. Co.
RCA Manufacturing
Republic Flow Meters

MOISTURE CONTENT

of

WOOD
VENEERS
PLYWOOD
EXCELSIOR
STRAW
PULP
PAPER

CELLOPHANE
GLASSINE
PLASTER
LEATHER
FABRICS
WOOL TOPS
NUTS

BUILDING AND ELECTRICAL INSULATING MATERIALS

and many other materials can be determined instantly and accurately with one of our small, light, portable, battery-operated gauges.

Look for this symbol of reliability on the meter dial.

KAYDEL
MOISTURE GAUGES
126 Liberty Street, New York 6, N. Y.

**MOTOR STARTERS (See Starters, Motor)**

**MOTORS, Fractional H. P.**
Amglo Corp.
Barber-Colman Co.
Bodine Elec. Co.
Burke Electric Co.
Cyclohm Div.
DeJur-Amsco Corp.
Dorothea Mechanisms, Gale
Eclipse-Pioneer Div.
Eicor, Inc.
Electric Indicator
Electro Engrg. Products
Electro Mechano Co.
Fairchild Camera
Ford Instrument
General Elec. Co.
Gleason-Avery, Inc.
Globe Industries
G-M Laboratories
Hathaway Instrument
Haydon Co., A. W.
Holtzer-Cabot Elec.
International Register
Kollsman Inst. Div.
Lear, Inc.
L & L Mfg. Co.
Marble-Card Elec.
Marco Industries
Merkle-Korff Gear Co.
Norcross Corp.
Oster Mfg. Co.
Raytheon Mfg. Co.
Redmond Co.
Reeves Instrument
Robinette Co., W. C.
Robbins & Meyers
Schwien Eng. Co.
Signal Electric Mfg.
Small Motors, Inc.
Sperry Gyroscope Co.
Standard Dayton Corp.
Summers Gyroscope
Telechron, Inc.
Transicoil Corp.

**MOTORS, Geared**
Ace Instrument
Amglo Corp.
Barber-Colman
Bodine Electric
Brown Inst. Div.
Cramer Co., Inc.
Cyclohm Div.
Dorothea Mechanisms, Gale
Eclipse-Pioneer Div.
Eicor, Inc.
Electro Engrg. Products
Ford Instrument
General Elec. Co.
Gleason-Avery
Hansen Mfg. Co.
Haydon Co., A. W.
Heller Co.
Holtzer-Cabot Elec.

(Continued)

Lear, Inc.
Merkle-Korff Gear Co.
Oster Mfg. Co.
Robbins & Myers
Schwien Eng. Co.
Servomechanisms, Inc.
Small Motors, Inc.
Standard Dayton Corp.
Summers Gyroscope
Transiciol Corp.
Warren Telechron

**MOTORS, Laboratory**
Amglo Corp.
Arma Corp.
Barber-Colman
Bodine Elec. Co.
Brown Inst. Div.
Central Scientific Co.
Cramer Co., Inc.
Cyclohm Div.
Dorothea Mechanisms, Gale
Eicor Inc.
Electric Indicator
Electro Engrg. Products
Ford Instrument
General Elec. Co.
Gleason-Avery
Heller Co.
Holtzer-Cabot Elec.
Kollsman Inst. Div.
L. A. B. Corp.
L & L Mfg. Co.
Machlett & Son
Marco Industries
Merkle-Korff Gear Co.
Oster Mfg. Co.
Palo-Myers, Inc.
Parr Instrument Co.
Robbins & Myers
Small Motors, Inc.
Summers Gyroscope
Telechron, Inc.
Times Facsimile Corp.
Welch Scientific
Westinghouse Elec.

**MOTORS, Synchronous**
Alina Corp.
Barber-Colman
Beck Co.
Bendix Marine Products
Bodine Elec. Co.
Burke Electric Co.
Coleman Instruments
Columbia Elec. Mfg.
Cramer Co., Inc.
Cyclohm Div.
Doelcam Corp.
Dorothea Mechanisms, Gale
Eclipse-Pioneer Div.
Eicor Inc.
Elec. Indicator Corp.
Electyme Motor Prods.
Fairchild Camera

(Continued)

**HIGH - PRECISION INSTRUMENT - TYPE**

# MOTORS & GENERATORS

## SPECIALLY-DESIGNED & MANUFACTURED • RATINGS FROM 1/3000 – 1/6 hp

- GOVERNOR-CONTROLLED
- SELF-SYNCHRONOUS
- DRAG CUP
- DC & AC TACHOMETER
- SHUNT
- SERIES
- COMPOUND
- PERMANENT-MAGNET
- SPLIT-FIELD
- SEPARATELY EXCITED
- UNIVERSAL
- INDUCTION
- RELUCTANCE
- HYSTERESIS
- ONE- TWO- & THREE-PHASE
- DC & AC SERVO
- TOTALLY ENCLOSED
- AC DYNAMICALLY BRAKED
- REELMOTORS
- ONE-, TWO-, THREE- & FIVE-SPEED SYNCHRONOUS MOTORS
- STABILIZED HYSTERESIS

**IN A WIDE VARIETY OF FRAME TYPES AND SIZES**

## THERE ARE OVER 600 BASIC MODELS TO MEET YOUR NEEDS

Though we do not carry units in stock, the wide range in types and specifications of the over 600 basic models will usually allow a customer to select one that meets his specifications; or a basic model may be easily varied to meet the most unique and exacting specifications. Every unit is designed and manufactured to order and individually tested to insure meeting specified requirements in every respect.

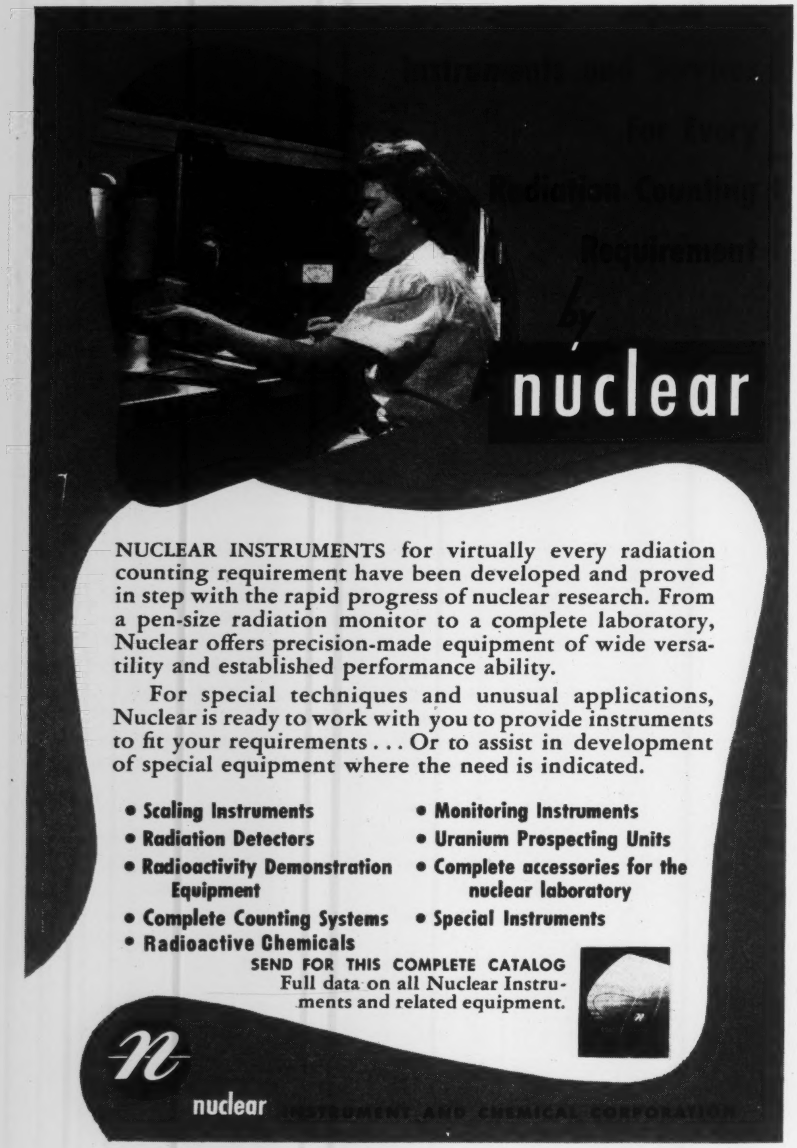
ELINCO

When inquiring or requesting quotations, you must submit detailed description of your problem so we may forward the proper literature and information promptly.

**ELECTRIC INDICATOR CO.**
**CAMP AVENUE SPRINGDALE, CONN.**

## NOTE:

Our business is solely in the design, engineering, and production of special units. They are for use, and are economical, only when the highest standards of performance are required. Every unit is a high precision instrument manufactured with appropriate skill and care. We do not "sell from stock" or compete with low-cost, mass-production units (i.e.: for appliances, low-cost tools, etc.). If your requirements demand a manufacturer of proven ability, with a reputation over many years for designing and producing to the highest standards and most exacting specifications, Elinco can then serve your needs.



Instruments and Service For Every Radiation Counting Requirement by nuclear

NUCLEAR INSTRUMENTS for virtually every radiation counting requirement have been developed and proved in step with the rapid progress of nuclear research. From a pen-size radiation monitor to a complete laboratory, Nuclear offers precision-made equipment of wide versatility and established performance ability.

For special techniques and unusual applications, Nuclear is ready to work with you to provide instruments to fit your requirements . . . Or to assist in development of special equipment where the need is indicated.

- **Scaling Instruments**
- **Radiation Detectors**
- **Radioactivity Demonstration Equipment**
- **Complete Counting Systems**
- **Radioactive Chemicals**
- **Monitoring Instruments**
- **Uranium Prospecting Units**
- **Complete accessories for the nuclear laboratory**
- **Special Instruments**

SEND FOR THIS COMPLETE CATALOG
Full data on all Nuclear Instruments and related equipment.

nuclear INSTRUMENT AND CHEMICAL CORPORATION

243 West Erie Street, Chicago 10, Illinois, Cable Address: ARLAB, N. Y.

Ford Instrument
General Elec. Co.
Gleason-Avery
Hansen Mfg. Co.
Haydon Mfg. Co.
Holtzer-Cabot Elec.
International Register
Kollsman Inst. Div.
Merkle-Korff Gear Co.
Oster Mfg. Co.
Robbins & Myers
Sangamo Electric Co.
Schwien Eng. Co.
Servomechanisms, Inc.
Small Motors, Inc.
Sperry Gyroscope
Summers Gyroscope
Telechron Inc.
Times Facsimile Corp.
Transicoil Corp.

**MOUNTINGS, Shock & Vibration Asorbing**
Barry Corp.
Goodrich Co.
Lord Manufacturing Co.
M. B. Mfg. Co.

**MUD ANALYSIS**
Braun Corp.
Johnson-Williams Ltd.
Menlo Research Lab.

**MUD SCALES (See Scales, Mud)**

**MULTIPLE SCALE METERS**
American Elec. Sales Co.
Clough-Brengle Co.
Cole Instrument
Electric Des. & Mfg.
Electronic Dev. Lab.
General Elec. Co.
Marion Elec. Instrument
M. B. Mfg. Co.
Meters, Inc.
Precision Aparatus Corp.
Rawson Elec. Inst. Co.
Sensitive Research Inst.
Shallcross Mfg.
Simpson Electric Co.
Supreme Inst. Corp.
Triumph Mfg. Co.
Westinghouse Elec.
Western Electro-Mech.

**MULTIPLIERS**
Cole Instrument
Daven Co.
Electronic Dev. Lab.
Electronic Instrument
Feiler Engineering
General Elec. Co.
Instrument Resistors Co.

(Continued)

International Resistance
Precision Resistor Co.
Sensitive Research Inst.
Shallcross Mfg.
Simpson Elec. Co.
Westinghouse Elec.
Weston Elec. Inst. Corp.

**MULTIPLIERS, High Voltage**
Cole Instrument
Electro-Tech Equipment
Feiler Engineering
Precision Apparatus Co.
Shallcross Mfg. Co.
Weston Elec. Inst

**NAUTICAL INSTRUMENTS**
American Paulin System
Baker Compass Co.
Bausch & Lomb Optical
Bendix Marine Products
Betts & Betts
Bliss & Co.
Cook Electric
Doelcam Corp.
Dusenbery Co.
Eastern Specialty Co.
Eclipse-Pioneer Div.
Elec. Tachometer Corp.

(Continued)

Federal Telephone
Geophysical Inst. Co.
Hand & Sons
Hastings Inst. Co.
Heiland Research
Jacobs Instruments
Kenyon Instrument Cc.
Leupold & Stevens
Marine Compass Co.
Maxson Corp.
Moeller Instrument Co.
Moisture Register Co.
National Co.
Negus T. S. & J. D.
RCA
Rieker Instrument Co.
Ritche & Son
Serdex, Inc.
Sperry Gyroscope
Stafford Co.
Thompson Clock Co.
White Co., David

**NAVIGATIONAL INSTRUMENTS**
Abrams Instrument
Aero Electronics
Arma Corporation
Baker Compass Co.
Bausch & Lomb Optical
Bliss & Co.

(Continued)

Boes Co., W. W.
Collins Radio Co.
Doelcam Corp.
Dusenberg Co.
Eastern Science Co.
Eastern Specialty Co.
Eclipse-Pioneer Div.
Elgin National Watch
Federal Telephone
Flader, Inc., Frederic
Flight Research
Ford Instrument
General Elec. Co.
Hand & Sons
Hastings Inst. Co.
Heiland Research
Keuffel & Esser Co.
Lear, Inc.
Leupold & Stevens
Marine Compass Co.
Martin-Hubbard Corp.
Negus, T. S. & J. D.
RCA
Ritchie & Son
Sperry Gyroscope
Stafford Co.
Summers Gyroscope
Triplett Elec. Inst.
Vectron, Inc.
Weston Electrical Inst.
White Co.

**NEEDLES, Asphalt Penetration**
Alpha Instrument Co.
Central Scientific Co.
Fisher Scientific Co.
Humboldt Mfg. Co.
Koehler Instrument
Olsen Testing Mach.
Precision Scientific
Tagliabue Div.
Van Keuren Co.

**NEEDLES, Dip**
Dusenbery Co.
Gurley, W. & L. E.
Marine Compass Co.

**NEEDLES, Gillmore**
American Inst. Co.
Central Scientific Co.
Fisher Scientific Co.
Humboldt Mfg. Co.
Olsen Testing Mach.
Precision Scientific
Riehle Div.

**NEEDLES, Penetration (See Needles, Asphalt Penetration)**

**NEEDLES, Vicat**
American Inst. Co.
Central Scientific Co.
Olsen Testing Machine
Fisher Scientific Co.
Humboldt Mfg. Co.
Riehle Div.

**NEPHELOMETERS**
Baird Associates
Central Scientific Co.
Coleman Instrument
Fisher Scientific
Hellige, Inc.
Klett Mfg. Co.
Leitz, Inc.
Photovolt Corp.
Rubicon Co.
Zeiss, Inc., Carl

**NESSLER TUBES**
Ace Glass Inc.
Central Scientific Co.
Fischer & Porter
Fish-Schurman Co.
Fisher Scientific Co.
Hellige, Inc.
Kimble Glass Co.
Kontes Glass Co.
LaMotte Chemical Prod.
Podbielniak, Inc.
Scientific Glass App.
Specialty Glass Co.

**NEUTRON SOURCES**
U. S. Radium Corp.

**NITROGEN DETERMINATION APPARATUS**
Ace Glass Inc.
Aloe Co., A. S.
Boekel & Co.
Central Scientific Co.
Chicago Apparatus Co.
Fisher Scientific Co.
Laboratory Construction
Laboratory Equip. Corp.
Microchemical Service
Podbielniak, Inc.
Precision Scientific Co.
Rubicon Co.
**Sargent & Co.**
Scientific Glass Apparatus
Tagliabue Div.
Taylor & Co., W. A.

**NOISE ANALYZING APPARATUS**
Aerovox Corp.
Brush Development Co.
Electronic Associates
Electronic Design Corp.
Empire Devices, Inc.
Engineering Res. & Dev.
General Elect. Co.
General Radio Co.
Kay Electric
RCA
Scott, Inc., Hermon
Televiso Co.

**NOISE FILTERS**
Aerovox Corp.
Amer. Communications
Electro Products Labs.
Empire Devices, Inc.
Kellogg Switchboard
Scott, Inc., Hermon
Technology Instrument
Tobe Deutschman Corp.
Thordarson Electric
United Transformer

**NOISE MEASURING SETS**
Amperite Co.
Ballantine Labs.
Daven Co.
Electronic Dev. Lab.
Empire Devices, Inc.
Engineering Res. & Dev.
Ferris Inst. Corp.
General Elec. Co.
General Radio Co.
Kay Electric
Measurements Corp.
Scott, Inc., Hermon
Sound Apparatus Co.
Tobe Deutschman Corp.
Western Electric

**NOISE RECORDING APPARATUS**
Alden Products
Audio Instrument
Brush Development Co.
Engineering Res. & Dev.
General Radio Co.
RCA
Sound Apparatus Co.

**NOZZLES, Flow**
Airflo Instrument
Askania Regulator
Bacharach Indust. Inst.
Bailey Meter Co.
Bristol Co.
Brown Inst. Div.
Builders-Providence
Foxboro Co.
Hagan Corp.
OPW Corp.
Penn Ind. Inst. Corp.
Phoenix Prec. Inst.
Republic Flow Meters
Simplex Valve & Meter
Taylor Inst. Cos.

**NUCLEAR MEASURING DEVICES**
Automatic Temp. Control
Berkeley Scientific
Canadian Radium
Cyclotron Specialties
Distillation Products
El-Tronics, Inc.
Ferner Co.
General Electric Co.
Geophysical Instrument
Herbach & Rademan
High Voltage Eng.
Instrument Dev. Labs.
Kelley-Koett Inst. Div.
Krohn-Hite Inst.
Loudon Insts.
Lovins Engr.
Martin-Hubbard Corp.
Menlo Research Lab.
Morgan Instrument
Nuclear Instrument
Nuclear Research & Dev.
Nucleonic Corp.
Potter Instrument
Precision Radiation Insts.
Radiation Counter Labs.
Standard Scientific Supply
Sylvania Electric
Technical Associates
Tracerlab, Inc.
Victoreen Inst. Co.
Wood Counterlab

**NULL DETECTOR**
Brown Electro-Meas.
General Radio
Hewlett-Packard
MacDonald Co., W. S.
Marion Electrical Inst.
Millivac Instrument
Shallcross Mfg. Co.

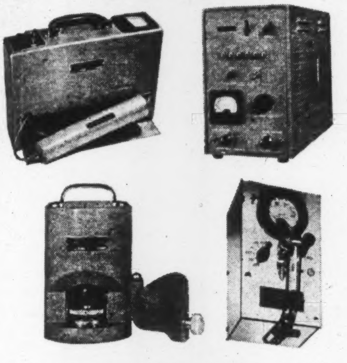
**OCEANOGRAPHIC INSTRUMENTS AND EQUIPMENT**
G. M. Mfg. Co.
Kahl Scientific Inst.
Leupold & Stevens
Southwestern Ind. Elec.
Wallace & Tiernan

**OCTANTS, NAVIGATING**
Bausch & Lamb Optical
Eclipse-Pioneer Div.
Fairchild Camera
Link Aviation Devices

**ODOMETERS**
Elec. Tachometer Corp.
Jones Motrola
Matthews Instrument

**OHMMETERS**
Associated Research
Biddle Co., James G.
Burlington Inst. Co.
Chicago Indust. Inst.
Clippard Inst. Lab.
Clough-Brengle Co.
Cole Instrument
Dale Instruments
DeJur-Amsco Corp.
Electronic Dev. Lab.
Electronic Instrument
Electronic Mfg.
Electro-Tech Equip.
Esterline-Angus
General Elec. Co.
Gray Instrument
Hickok Elec. Inst.
Industrial Inst. Co.
Kellogg Switchboard
Leeds & Northrup Co.
M. B. Mfg. Co.
Meters, Inc.
National Tech. Labs.
Precision Apparatus
Radio City Products
RCA Div.
Reiner Electronics
Roller-Smith
Sensitive Research Inst.
Simpson Elec. Co.
Sticht Co.
Triplett Elec. Inst.
Welch Scientific
Westinghouse Elec.
Weston Elec. Inst. Corp.
Wheelco Inst. Co.

TECHNICAL ASSOCIATES
Instruments for Nuclear Research



Designers and custom builders of Scale-O-Matic counting circuits, Geiger Mueller counter tubes, portable radiation detectors, pulse generators, linear amplifiers, and lead shields.

TECHNICAL ASSOCIATES
3730 SAN FERNANDO ROAD
GLENDALE 4, CALIFORNIA

**OHMMETERS, Millohmmeters**
Burlington Inst. Co.
Cambridge Inst. Co.
Cole Instrument
Dale Instruments
Dice Co., J. W.
Electro-Tech Equip. Co.
Electronic Development
Electronic Dev. Lab.
Feiler Engineering
General Elec. Co.
Hickok Elec. Inst. Co.
Marion Electrical Inst.
National Tech. Labs.
Radio City Products
Rawson Elec. Inst. Co.
RCA Div.
Reiner Electronics
Sensitive-Research Inst.
Shallcross Mfg. Co.
Simpson Mfg. Co.
Sticht Co.
Triumph Mfg. Co.
Weston Elec. Inst. Corp.

**OIL CENTRIFUGE TUBES**
Corning Glass Works
Freas Glass Works
H-B Instrument Co.
Kimble Glass Co.
Kontes Glass Co.
Moeller Inst. Co.
Podbielniak, Inc.
Precision Scientific

**OIL, Lubricating for Instruments & Watches See Instrument Oils)**

**OIL TESTING INSTRUMENTS**
American Inst. Co.
Boekel & Co.
Brabender Corp.
Braun Corp.
Central Scientific Co.
Cook Research Labs.
Dillon & Co.
Fish-Schurman Co.
Fisher Scientific Co.
Gardner Laboratory
General Elec. Co.
Gerin Corp.
H-B Instrument Co.
Hellige, Inc.
Humboldt Inst. Inc.
Industrial Inst. Inc.
Klett Mfg. Co.
Koehler Instrument
Menlo Research Lab.
Mico Instrument Co.
Moeller Instrument Co.
Moisture Register Co.
Parr Instrument Co.
Photovolt Corp.
Podbielniak, Inc.
Precision Scientific Co.
Refinery Supply
Ruehfel Co.
Ruska Inst. Corp.
Sargent & Co.
Scientific Glass App.
Scientific Inst. Co.
Taylor Inst. Cos.
Thomas Co., Arthur H.
Trimount Inst. Co.
Ultra-Violet Products
Visco-meter Corp.
Weksler Thermometer

**OIL WELL TESTING INSTRUMENTS**
Coleman Instrument
Geophysical Inst.
Geotechnical Corp.
Heiland Research
Johnson-Williams, Ltd.
Menlo Research Lab.
Podbielniak, Inc.
R-C Scientific Inst.
Ruska Inst. Corp
Sperry-Sun Well Survey.

**OPACIMETERS**
American Inst. Co.
Bausch & Lomb Optical
Electronic Prod. Co.
Gaertner Scientific
Gardner Laboratory
Photovolt Corp.

**OPERATION, Indicators**
Automatic Elec. Sales
Bristol Co.
Brown Inst. Div.
Eclipse-Pioneer Div.
Elec. Tachometer Corp.
Foxboro Co.

**OPERATION, Recorders**
Alfax Ind. Inst.
Abrams Instrument
Amthor Testing Inst. Co.
Autocall Co.
Automatic Elec. Chicago
Bacharach Ind. Inst.
Bristol Co.
Brown Inst. Div.
Cincinnati Time Rec.
Cole Instrument
Cramer & Co., Inc.
Dickson Co.
Elec. Tachometer Corp.
Esterline-Angus Co.
Foxboro Co.
**Friez Instrument**
Gaertner Scientific Corp.
Instrument Lab. Inc.
Marsh Corp.
McDonnell Odometer
Paragon Electric Co.
Tagliabue Div.

(Continued)

SYNCHROS
PRECISION-BUILT BY
ECLIPSE-PIONEER
GUARANTEED ACCURACY TO WITHIN 15 MINUTES ON ALL PRODUCTION UNITS

For more than 17 years Eclipse-Pioneer has been a leader in the development of high precision synchros for aircraft, marine and industrial applications. Today, thanks to this long experience and specialization, Eclipse-Pioneer Autosyn* Synchros give you a *guaranteed* accuracy of 15 minutes (maximum) on all individual AY 200 type 400 cycle transmitters, differential generators, control transformers and resolvers. Furthermore, this phenomenal accuracy applies to *all production units* in this series. Where special applications are involved, Eclipse-Pioneer will supply Autosyn Synchros with an even *finer* degree of accuracy. And remember, when you buy from Eclipse-Pioneer, this high precision is yours at the lowest possible cost.

*REG. TRADE MARK BENDIX AVIATION CORPORATION

LOOK FOR THE PIONEER MARK OF QUALITY REG. U.S. PAT. OFF.

Typical Performance Characteristics for one AY-201-3 Autosyn Synchro when transmitting to:

| | One Control Transformer | Two Control Transformers | Three Control Transformers |
|---|---|---|---|
| **INPUT** | | | |
| Voltage | 26-volts, single-phase | 26-volts, single-phase | 26-volts,single-phase |
| Frequency | 400 cycles per second | 400 cycles per second | 400 cycles per second |
| Current | 105 milliamperes | 130 milliamperes | 155 milliamperes |
| Power | 0.90 watts | 1.4 watts | 1.9 watts |
| Impedance | 85+j240 ohms | 80+j180 ohms | 77+j149 ohms |
| **OUTPUT** | | | |
| Voltage max. (rotor output) | 18.0 volts | 15.5 volts | 13.3 volts |
| Voltage at null | 30 millivolts | 20 millivolts | 20 millivolts |
| Sensitivity | 315 millivolts/degree | 270 millivolts/degree | 230 millivolts/degree |
| Voltage phase shift | 18.5 degrees | 24.5 degrees | 28.0 degrees |
| System accuracy (max. possible spread) | 0.5 degrees | 0.5 degrees | 0.5 degrees |

Other E-P precision components for servo mechanism and computing equipment:
Servo motors and systems • rate generators • gyros • stabilization equipment • turbine power supplies • remote indicating-transmitting systems and special purpose electron tubes.

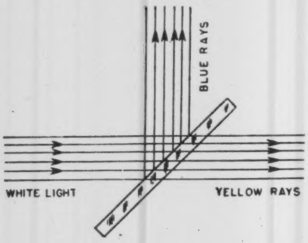
*For detailed information, write to Dept. A*

ECLIPSE-PIONEER DIVISION of
TETERBORO, NEW JERSEY
Bendix
AVIATION CORPORATION

Export Sales: Bendix International Division, 72 Fifth Avenue, New York 11, N. Y.

FS MULTI-LAYER INTERFERENCE FILMS

Dichroic & Achromatic Beam Splitters



Chromatic Spectral Selection Effect; a certain portion of the spectrum is reflected, the remainder transmitted.

Achromatic Spectral Selection Effect; the incident light is split into two beams, one reflected, one transmitted, each beam retaining the spectral properties of the original incident beam.

Transmission or reflection peaks as high as 85 to 90% but the spectral bands are relatively broad.

Submit your problems and ask for bulletin MI-318 giving graphs of standard types now available.

FISH-SCHURMAN CORPORATION
62 Portman Road, New Rochelle, N. Y.

Fish-Schurman FS TM REG

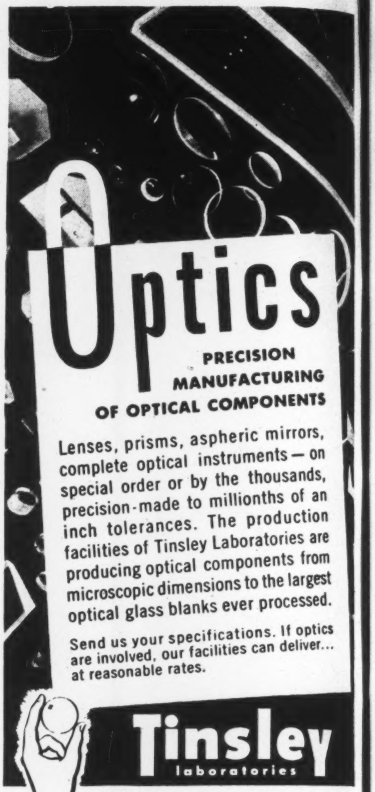
**OPTICAL BENCHES** (See Benches, Optical)

**OPTICAL FILTERS** (See Filters, Optical)

**OPTICAL FLATS** (See Flats, Optical)

**OPTICAL MICROMETERS** (See Micrometers, Optics)

**OPTICAL PARTS**
Alpha Instrument Co.
American Optical
Baird Associates
**Bayside Watch Tool**
Bausch & Lomb Optical
Binswagner & Co.
Bolsey Corp.
Bray Optical Co.
Buchele Optical Co.
Cal-Astro Optical Labs.
Clark & Sons
Curtiss Labs.
Dearborn Scientific
Dome Precision
E & S Optical
Electro-Physics
Fecker, Inc.
Fish-Schurman Co.
Gaertner Scientific Corp.
General Scientific
Geophysical Inst. Co.
Goerz Amer. Optical Co.
Hayward Scientific Glass
Henson Co., Fred C.
Herron Optical
Ice Optical Co., H. C.
International Glass
Industro-Scientific Co.
Jones Optical Works
Kollmorgan Optical Co.
Lancaster Lens
Leitz, Inc.
Lindly & Co.
Machlett & Son
Mann Co., W. I.
Optron Laboratory
Pacific Optical
Pacific Univ. Prod.
Palos Optical Co.
Penn Optical & Inst.
Perkin-Elmer Corp.
Plummer & Kershaw
Precise Measurements Co.
Republic Lens
Schneider-Cogswell
Simpson Optical
Stafford Optical
Stratex Instrument Co.
Tinsley Laboratories
Unertl Optical Co.
Univis Lens Co.


Optics
PRECISION MANUFACTURING OF OPTICAL COMPONENTS

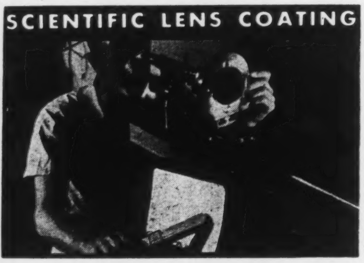
Lenses, prisms, aspheric mirrors, complete optical instruments—on special order or by the thousands, precision-made to millionths of an inch tolerances. The production facilities of Tinsley Laboratories are producing optical components from microscopic dimensions to the largest optical glass blanks ever processed.

Send us your specifications. If optics are involved, our facilities can deliver... at reasonable rates.

Tinsley laboratories
2532 GROVE ST • BERKELEY, CALIF.

High Precision OPTICAL COMPONENTS Any Size For Astronomical and Physical Research
•
Parabolic, Spherical, Ellipsoidal and Plane MIRRORS
•
Plane Parallel PLATES
•
SCHLIEREN SYSTEMS
•
Interferometer PLATES
•
LENSES and PRISMS of Glass
•
Natural or Synthetic CRYSTALS
•
Complete Optical and Mechanical INSTRUMENTS
•
Made to Specifications
•
High Vacuum Coating
•
John Unertl Optical Co.
3551-3555 East Street
Pittsburgh 14, Penna.

THERE'S NO SUBSTITUTE FOR EXPERIENCE

SCIENTIFIC LENS COATING


Consult our optical engineers for all your

HIGH VACUUM COATING
of lenses, prisms and specialized optical systems.
FIRST SURFACE MIRRORS
PLASTIC METALIZING

PACIFIC UNIVERSAL PRODUCTS CORP.
168 Vista Ave. Pasadena 6, Calif.

LENSES PRISMS
Designers and Manufacturers
of Your Requirements
For
PRECISION MADE OPTICS
Low Reflection Coatings
Optical Super Finishing of Metals
Plastic Lenses
*Also*
PRECISION GROUND LENSES

We are fully equipped for quantity production of fine quality lenses. We specialize in projection, telescope, microscope, photographic and sextant lenses—all types of prisms and filters. Quality of materials and workmanship guaranteed. State your needs. It is probable that we can serve you better.

SCHNEIDER-COGSWELL, INC.
1849 No. Halsted St., Chicago 14, Ill.

**Somco**

SOMCO's steady progress for over a quarter of a century has been the inevitable result of the SOMCO policy of sound engineering, skilled workmanship and uncompromising adherence to the most rigid standards. SOMCO engineers are constantly developing new ideas for the application and economical production of lenses—prisms—complex optical systems embodying the latest designs and methods in the ever-broadening field of precision optics.

***SOMCO PRODUCTS INCLUDE***

**PROJECTION LENSES • CAMERA LENSES • SOUND OPTICAL SYSTEMS**

**PRISMS • RETICLES • SILVERING AND ALUMINIZING**

**SOMCO LENS COATING FOR MAXIMUM LIGHT TRANSMISSION**

SIMPSON OPTICAL CO.

**Simpson Optical**

MANUFACTURING COMPANY

3200 West Carroll Avenue, Chicago 24, Illinois

EVAPORATED metal films CORPORATION OF ITHACA

REFLECTIONS
on
REFLECTIONS

1. CHROLUMINUM first-surface MIRRORS reflect between 85% and 95% throughout the infra-red, visible, and near ultra-violet spectral regions.
2. CHROLUMINUM MIRRORS are of superior optical quality; are amply hard and durable for use in instruments and most optical equipment.
3. CHROLUMINUM MIRRORS are available now, and are less expensive than you might think.

Made by EVAPORATED of Ithaca

*Since 1935 Manufacturer of Opaque and Semi-Transparent Mirrors*

Free descriptive folder on request

EVAPORATED METAL
FILMS CORPORATION
ITHACA, NEW YORK

**OPTICAL PARTS, Fused Quartz**
Acme Scientific
American Lens
Bausch & Lomb
Cal-Astro Optical Labs.
Crystal Research Labs.
Dearborn Scientific
Engis Equipment
Farrand Optical
Fecker, Inc.
Ferner Co.
Fish-Schurman Corp.
Gaertner Scientific
Geophysical Inst. Co.
Henson Co., Fred C.
Howland Optical Co.
Ice Optical Co., H. C.
Jones Optical Works
Lindly & Co.
Mann Co., W. I.
Optron Laboratory
Palos Optical Co.
Perkin-Elmer Corp.
Plummer & Kershaw
Republic Lens
Thermal Syndicate Ltd.
Tinsley Laboratories
Unertl Optical Co.
Zenith Optical Co.

**OPTICAL PROJECTORS (See Projectors)**

**OPTICAL TESTING INSTRUMENTS (See Testing Instruments, Optical)**

**OPTIMETERS**
Amer. Measuring Insts.
Scherr Co., Inc.
Zeiss. Inc., Carl

**ORIFICE METERS, (See Flow Meters, Orifice)**

**ORIFICE FITTINGS**
Builders-Providence
Daniel Orifice Fitting
Foxboro Co.
Hagan Corp.
Penn Ind. Instrument
Robinson Orifice Fitting
Simplex Valve & Meter

**ORIFICES, CALIBRATED (See Flow Meters, Orifice)**

**ORIFICE PLATES (See Flowmeters, Orifice)**

**ORIFICES, ADJUSTABLE**
American Meter Co.
Bailey Meter Co.
Scientific Inst. Co.

**ORSAT GAS APPARATUS (See Gas Analyzers, Orsat)**

**ORTH-TOLIDIN TESTING OUTFIT**
Hellige, Inc.
LaMotte Chem. Prods.
Permutit Co.
Taylor & Co., W. A.
Wallace & Tiernan

**OSCILLATORS, Audio-frequency**
Amer. Communications
American Time Prods.
Amplifier Co.
Audio Development
Boonton Radio Corp.
Cambridge Inst. Co.
Central Scientific
Clippard Inst. Lab.
Clough-Brengle Co.
Commun. Meas. Lab.
Control Corp.
Electro-Medical Lab.
Electro Products Labs.
Electro-Tech. Equip.
Electronic Dev. Lab.
Electronic Instrument
Electronic Mfg. Co.
Electronic Prod. Co.
Engineering Res. & Dev.
Feiler Engineering
Ferris Inst. Corp.
Freed Transformer
General Elec. Co.
General Radio Co.
Geophysical Inst. Co.
Hathaway Inst. Co.
Hewlett-Packard
Hickok Elec. Inst. Co.
Islep Radio Mfg.
Jackson Elec. Inst.
Krohn-Hite Inst.
Leeds & Northrup Co.
Lewyt Metal Prod.
Madison Elec. Prod.
Measurements, Inc.
Millen Mfg. Co.
Phillips Petroleum
Polarad Electronics
Radio City Products
Rahm Instruments
RCA Div.
Reiner Electronics
Sherron Metallic
Southwestern Ind., Elec.
Sylvania Elec. Prod.
Televiso Co.
Thordarson Elec. Mfg.
Trimount Inst. Co.
Triplett Electrical Inst.
Triumph Mfg. Co.
Ultrasonic Engr. Co.
Walkirt Co.
Waterman Products
Wiancko Engineering

**OSCILLATORS, Microwave**
Amer. Electroneering
General Electric Co.
Hewlett-Packard
Kay Electric Co.
Lavoie Labs.
Raytheon Mfg. Co.
RCA Div.
Sperry Gyroscope Co.
Sylvania Elec. Prod.

Precision
Optical Windows
All Types

Photographic
Schlieren
Sighting
Interferometer

Related Optical
Products

OPTRON LABORATORY
2725 Salem Avenue
Dayton 6, Ohio

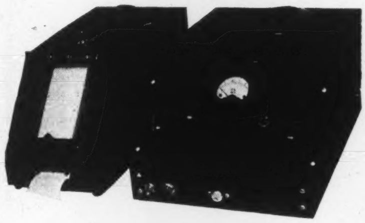
**OSCILLATORS, Radio-frequency**
Aerovox Corp.
Airborne Inst. Laboratory
Audio-Tone Oscillator
Bliley Electric Co.
Boonton Radio Corp.
Bradshaw Instruments
Clarke Inst. Corp.
Clippard Corp.
Clough-Brengle Co.
Collins Radio Co.
Crystal Research
Electro-Medical Lab.
Electronic Dev. Lab.
Electronic Instrument
Electronic Mfg. Co.
El-Tronics, Inc.
Engineering Res. & Dev.
Feiler Engineering
Ferris Inst. Corp.
Freed Transformer
General Electric Co.
General Radio Co.
Geophysical Inst. Co.
Harvey Radio Labs.
Hewlett-Packard
Hickok Elec. Inst. Co.
Islip Radio Mfg.
Jackson Electrical Inst.
Kay Electric
Lavoie Laboratories
Lewyt Metal Prod.
Lyman Electronic
McFarlin Co.
Measurements Corp.
Millen Mfg. Co.
Polarad Electronics
Precision Apparatus
Premier Crystal Labs.
Rahm Instruments
RCA Div.
Rollin Co.
Sherron Metallic
Simpson Elec. Co.
Sperry Gyroscope
Standard Piezo Co.
Sylvan Electronic Labs.
Sylvania Elec. Prod.
Technology Instrument
Televiso Co.
Triplett Electrical Inst.
Triumph Mfg. Co.
Ultrasonic Engr. Co.
Walkirt Co.
Waterman Products Co.
Weston Elec. Inst. Corp.

**OSCILLATORS, Ultrasonic**
Audio-Tone Oscillator
Gen. Precision Lab.
General Radio
Hewlett-Packard
Kay Electric
Reed Research
Southwestern Ind. Elec.
Sperry Products
Ultrasonic Engr. Co.

**OSCILLOGRAPHS, Automatic**
Brush Development
Century Geophysical
Consolidated Engg.
Electro-Tech Equip. Co.
Feiler Engineering
General Elec. Co.
Geotechnical Corp.
Hathaway Instruments
Heiland Research
Sherron Metallic
United Cinephone Corp.
Waterman Products Co.
Westinghouse Elec.

**OSCILLOGRAPHS, Cathode ray**
American Lens Co.
Beam Instrument
Bradshaw Instruments
Browning Labs.
Central Scientific
Clippard Inst. Lab.
Clough-Brengle Co.
Cole Instrument
Commercial Research
Dayton Acme Co.
DuMont Labs., Inc., A. B.
Eitel McCullough
Electro-Medical Lab.
Electro Products Lab.
Electronic Dev. Lab.
Electronic Instrument
Electronic Tube
Engineering Res. & Dev.
Federal Telephone
Feiler Engineering
Fredericks, George
Furst Electronics
General Elec. Co.
General Radio Co.
Hathaway Inst. Co.
Heiland Research
Hickok Elec. Inst. Co.
Hytron Radio & Elec.
Industrial Electronics
Jackson Electrical Inst.
Lavoie Labs.
Millen Mfg. Co.
North Amer. Philips
Precision Apparatus
Process & Instruments
Rauland Corp. (Tubes)
Raytheon Mfg. Co.
RCA Div.
Supreme Instruments
Standard Arcturus
Sylvania Elec. Prod.
Tektronix, Inc.
Thordarson Elec. Mfg.
Triplett Electrical Inst.
Triumph Mfg. Co.
United Transfer Corp.
Walker-Jamieson, Corp.
Waterman Prod. Co.
Wyland (Tubes)

**Recording Instruments**



Photron oscillographs and amplifiers providing instantaneous strip chart recordings.

Furnished in many different types to fulfill your particular recording needs.

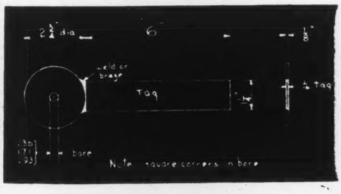
**PHOTRON INSTRUMENT COMPANY**

6516 Detroit Ave. Cleveland 2, Ohio

**ORIFICE PLATES**

**Ring gasket and orifice plate for ring type flanges**

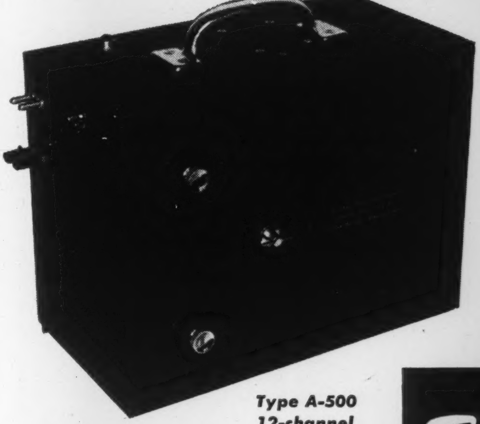
**Blank plates and tags carried in stock**



**E. W. TURNER ELECTRIC CO.**

6138-40 N. BEECHWOOD ST.
P.O. BOX 6564
PHILADELPHIA 38, PA.

**FOR RECORDING strains**



*Type A-500*
*12-channel*

- Portable
- Compact (6 3/4" x 9 13/16" x 12 3/4")
- Light weight (33 lbs.)
- Easy loading
- 2 to 12 channels
- Many other features found only in much larger recorders

**dependable instruments**

Heiland
DENVER

**Oscillograph Recorder**

• The Heiland 500, because of the extremely small size and light weight, is widely used in aircraft and guided missile testing and by industrial and general research laboratories. The use of highly sensitive Heiland galvanometers permits the measurement of strains without the use of amplifiers.

*For further information write*

**HEILAND RESEARCH CORPORATION** 130 East Fifth Street
Denver, Colorado, USA

### OSCILLOGRAPHS, Moving-conductor

Baldwin-Lima-Hamilton
Cambridge Inst. Co.
Century Geophysical
Edin Electronics
General Electric
Geophysical Inst. Co.
Hathaway Instruments
Heiland Research
Sanborn Co.
Waterman Products Co.
Westinghouse Elec.

### OSCILLOGRAPHS, Multi-element

Alden Products
Alfax Paper & Engg.
Baldwin-Lima-Hamilton
Beam Instrument
Brush Development
Cambridge Inst. Co.
Century Geophysical
Coleman Instrument
Consolidated Engg.
Edin Electronics
Electro-Medical Lab.
Electro-Tech Equip.
Engineering Labs., Inc.
Feiler Engineering
General Elec. Co.

(Continued)

Geophysical Inst. Co.
Geotechnical Corp.
Hathaway Instruments
Heiland Research
Sanborn Co.
Southwestern Ind. Elec.
Waterman Products Co.
Westinghouse Elec.

### OSCILLOGRAPHS, Piezoelectric

Baldwin Locomotive
Brush Development Co.
Cambridge Inst. Co.
Electro-Medical Lab.
Engineering Labs.
Geophysical Inst. Co.
McFarlin Co.
Waterman Products Co.

### OSCILLOGRAPHS, Recording

Alden Products
Alfax Paper & Engg.
Baldwin Locomotive
Brush Development
Cambridge Instrument Co.
Century Geophysical
Coleman Instrument
Consolidated Engg.
Edin Electronics
Electro-Medical Labs.

(Continued)

Electro-Products Lab.
Engineering Labs., Inc.
General Elec. Co.
General Radio Co.
Geotechnical Corp.
Hathaway Inst. Co.
Heiland Research Corp.
Martin-Hubbard Corp.
Offner Electronics
Photron Instrument
Rahm Instruments
Reed Research
Sanborn Co.
Southwestern Ind. Elec.
Sound Apparatus Co.
Triumph Mfg. Co.
Waterman Products Co.
Westinghouse Elec.

### OSCILLOSCOPES

Aeroquip Corp.
Beam Instrument
Browning Labs.
Brush Development Co.
Central Scientific Co.
Clippard Inst. Lab.
Clough-Brengle Co.
Cole Instrument
Commercial Research
DuMont Labs., Inc., A. B.
Electronic Dev. Lab.

(Continued)

Electronic Instrument
Electronic Tube
El-Tronics, Inc.
Feiler Engineering
Furst Electronics
General Elec. Co.
General Radio Co.
Harvey Radio Labs.
Hickok Elect. Inst.
Hycon Mfg.
Jackson Electrical Inst.
Lavoie Labs.
Millen Mfg. Co.
National Co.
Polarad Electronics
Precision Apparatus
Radio City Products
RCA Div.
Reiner Electronics
Sherron Metallic
Supreme Instruments
Sylvan Electronic Labs.
Sylvania Elec. Prod.
Tektronix, Inc.
Television Equipment
Thordarson Elec. Co.
Triumph Mfg. Co.
Ultrasonic Engr. Co.
Waterman Prod. Co.

(Continued)

**PHOTO LENSES FOR YOUR LAB., RESEARCH, ETC.**

- PROCESS LENSES
- SPECIAL RECORDING
- TIME LAPSE
- TELEPHOTO—(FOTOTEL)
- f:0.8 UP
- OSCILLOGRAPHY
- LENS COATING
- WIDE ANGLE
- PORTRAIT
- PRISMS
- SPECIAL MOUNTS
- TELEVISION

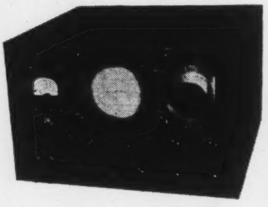
Your problem is simplified using our great and varied stock of lenses, representative of the best American and European makers. Focal lengths from ½ to 48 inches in practically all speeds and mounts. Test lenses are subject to a 15 day free trial. Our special facilities of personnel and shop (lens coating, mounting, etc.) are at your command. Feel free to write us for our complete lens list indicating your special interest. (Write Dept. Lens Lab.)

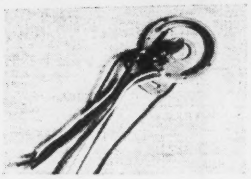
**BURKE & JAMES, Inc.** SINCE 1897 **CHICAGO, ILL.**

PRECISION ELECTRONIC TEST EQUIPMENT

MODEL 77 OSCILLOSYNCHROSCOPE

For the study of short duration pulses and microsecond time intervals, the Hycon Model 77 Oscillosynchroscope is unexcelled. Great flexibility for all types of pulse and delay measurements is provided. Sweeps of 10 μs, 30 μs, 100 μs, 300 μs, 1000 μs, and 3000 μs on internal or external trigger. Any 10 μs or 30 μs portion may be selected and expanded to 4 inches. P.R.F. is variable from 10 to 2000 CPS. Crystal controlled markers, spaced 10 μs and 50 μs, are locked with internal trigger. Self calibration of Y axis from a square wave generator whose amplitude is directly calibrated on a dial reading in 1/10th volts. Delay calibration micro-vernier dial readable to .05 μs. Video amplifier gain of 350 times, flat to 5 megacycles from 20 CPS, with six-step frequency-compensated attenuation up to 1000:1.





PRECISION POTENTIOMETER

The Hycon Precision Wire Wound Potentiometers are designed and manufactured to meet the critical performance requirements of guided missile components. Units are regularly produced with linear tolerance of ± 0.1%. Linear and non-linear potentiometers can be supplied to your design requirements within the resistance range of from 10 to 100,000 ohms with standard resistance tolerances of ± 5% and power ratings of 1 watt.

Hycon Mfg. Company

2961 E. Colorado St., Pasadena, California

207 Barr Bldg., 910 17th St. N.W. Washington, D. C.

WIDE BAND • HIGH GAIN

THE NEW TEC

FIVE INCH OSCILLOSCOPE

T-601-B

- Y AMPLIFIER 10 mv. rms/in. —3db 2cy to 12 Mc.
- X AMPLIFIER 250 mv. rms/in. —3db 2cy to 250 Kc.
- Z INPUT 1.5V. visible for marking
- RECURRENT SWEEP 10 cycles to 100 Kc.
- TRIGGERED SWEEP 10 ms. to $10^5$ ms.
- INTERNAL CALIBRATOR Measures 10 mv. to 500 v. P-P
- PROBE 10 mmf. 2 megohms
- PHASEABLE 60cy SWEEP & SYNC.
- $399.50 FOB N. Y. C.

TEC
POSITION
X POSITION
FOCUS
INTENSITY
SWEEP OUTPUT
CAL VOLTAGE PEAK TO PEAK
SYNC AMP
PULSE OUTPUT
SIGNAL ATTEN
SWEEP RANGE
SYNC SWEEP SELECTOR
PROBE
GND
VERNIER
TELEVISION EQUIPMENT CORP.
NEW YORK CITY

The TEC model T-601-B is a general purpose high quality cathode ray oscilloscope with all the features requisite to precision laboratory equipment. Sturdy construction, highest grade components and top engineering design, the T-601-B is widely used in the country's top laboratories.

WRITE FOR DETAIL SHEET N-92

TEC

TELEVISION EQUIPMENT CORP.

238 WILLIAM ST., NEW YORK 7, N. Y.

IN CANADA THE AHEARN & SOPER CO LTD OTTAWA

**OUTPUT METERS**
Alina Corp.
Assembly Products
Ballantine Labs.
Brush Development
Chicago Indust. Inst.
Clippard Inst. Lab.
Clough-Brengle Co.
Cole Instrument
Dale Instruments
Daven Co.
Electronic Development
Electronic Instrument
Electro Products Lab.
Electro-Tech Equip.
Feiler Engineering
General Elec. Co.
General Radio Co.
Hewlett-Packard
Hickok Elec. Inst.
Jackson Electrical Inst.
Marion Electrical Meters
M B Mfg. Co.
Meters, Inc.
Precision Apparatus
Radio City Products
RCA Div.
Reiner Electronics
Sensitive Research Inst.
Shallcross Mfg. Co.
Sylvania Elec. Prod.
Triplett Elec. Inst.
Westinghouse Elec.
Weston Elec. Inst. Corp.

**OVENS, Controlled atmosphere**
Distillation Products
DoAll Co.
Electric Hotpack
Laboratory Equip. Corp.
Precision Scientific
Sodermann Heat
Surface Combustion
Tenney Engineering

**OVENS, Crystal Oscillator**
Bliley Electric
Federal Telephone
Premier Crystal Labs.
RCA Div.
Valpey Crystals

**OVENS, Laboratory**
Aloe Co., A. S.
American Inst. Co.
Boekel & Co.
Bradender Corp.
Braun Corp.
Burrell Tech. Supply
Central Scientific Co.
Dietert Co.
Electric Hotpack
Falstrom Co.
Federal Telephone Co.
Ferner Co.
Fisher Scientific Co.
General Biological
Gordon Co.
Grieve-Hendry Co.
Huppert Co.
K & H Industrial Prods.
Lindberg Engineering
Modern Elec. Lab.
Precision Scientific
Sargent & Co.
Seedburo Equipment Co.
Sodemann Heat & Power
Standard Science Sup.
Standard Scientific
Stoelting Co., C. H.
Surface Combustion
Tenney Engineering
Thomas Co., Arthur H.
Valverde Labs.
Welch Scientific

**OVER & UNDERWEIGHT INDICATORS FOR BEAM SCALES**
Howe Scale Co.
Jacobs Bros. Co., Inc.
Photoswitch, Inc.
Seedburo Equipment Co.

**OXYGEN ANALYZERS (See Gas Analyzers, Oxygen)**

**OXYGEN & NITROGEN TESTING APPARATUS (See Gas Analyzers, Oxygen & Nitrogen Apparatus)**
Eclipse-Pioneer Div.
Grove Regulator
Mine Safety App. Co.

**OXYGEN DEMAND VALVES - Aircraft**
Eclipse-Pioneer Div.
Gadgets Inc.
Grove Regulator
Mine Safety Appliances

**OXYGEN REGULATORS Aircraft**
Bastian-Blessing Co.
Black Mfg. Co.
Cash Co.
Eclipse-Pioneer Div.
Gaertner Scientific
Grove Regulator
Linde Air Products
Mine Safety App. Co.
Nester Co., Inc., L. G.

**PAINT changing color with temperature**
Gordon Co., Claud S.
Tempil Corp.
Tenney Engineering

**PAINT HIDING POWER INSTRUMENTS (See Testers Paint)**

**PANEL LIGHTS, INSTRUMENT (See Pilot Lights)**

**PANELS, Instrument**
Allied Eng. & Stamp
Clark Cooper
Cole Instrument
Dittmore & Freimuth
Falstrom Co.
Industrol Corp.
Jones Motrola Corp.
Minneapolis-Honeywell
Nankervis Co., G. L.
Panellit Inc.
Taller & Cooper
Taylor Inst. Cos.
Weksler Thermometer

**PANTOGRAPHS**
Gaertner Scientific Corp.
Henchel & Co.
Keuffel & Esser Co.
Mico Instrument Co.
Speidel & Co.
Warren-Knight Co.
Weber Co.

**PARTICLE SIZE APPARATUS**
American Instrument
Braun Corp.
Mine Safety Appliances

**PASSOMETERS**
Keuffel & Esser Co.
Weber Co.
Zeiss, Inc., Carl

**PEDOMETERS**
Dietzgen Co.
Keuffel & Esser Co.
Testrite Instrument Co.
Warren-Knight Co.
Weber Co.
White Co., David

**PELLET PRESSES (See Presses, Pellet)**

**PELORUSES**
Arma Corporation
Bliss & Co.
Hand & Sons
Keuffel & Esser Co.
Laboratory Specialties
Leupold & Stevens
Marine Compass
Negus T. S. & J. D.
Pioneer Instrument Co.
Precision Therm.
Sperry Gyroscope
Stafford Co.
Thwing-Albert Inst. Co.
Warren-Knight Co.

**PENETROMETER NEEDLES (See Needles, Penetrometer)**

**PERISCOPES, Industrial & Smoke**
Brooke Engineering
Ess Inst. Co.
Fecker, J. W.
Kollmorgan Optical Co.
Lenox Inst. Co.
Penberthy Instrument Co.
Perkin-Elmer Corp.

**PERISCOPES, Military & Naval**
Bausch & Lomb
Bray Optical Co.
Buchele, W.
Fecker, J. W.
Keuffel & Esser Co.
Kollmorgan Optical Co.
Unertl Optical Co.

**PERMEAMETERS, Magnetic**
Aero Electronics
Annis Co.
Brownell, H. Russell
Cambridge Inst. Co.
Fisher Scientific Co.
General Elec. Co.
Hathaway Inst. Co.
Leeds & Northrup Co.
Rawson Elec. Inst.
Rubicon Co.
Welch Scientific

**PERMEAMETERS, Porosity**
Cambridge Inst.
Engineering Labs., Inc.
Fisher Scientific Co.
Humboldt Mfg. Co.
Precision Scientific
Ruska Inst. Corp.
Sheffield Corp.

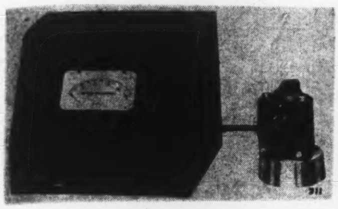
**pH METERS (See Hydrogen Ion Determination Instruments)**

**PHASE ANGLE METERS**
Amplifier Co.
Clarke Inst. Corp.
Cole Instrument
General Elec. Co.
Kollsman Inst. Div.
Leeds & Northrup Co.
RCA Manufacturing Co.
Rockwell Engr.
Rollin Co.
Sensitive Research Inst.
Triplett Elec. Inst.
Westinghouse Elec.
Weston Elec. Inst. Corp.

**PHASE INDICATORS**
Clarke Inst. Corp.
Cole Instrument
Feiler Engineering
Flight Research Eng.
Nosker Engineering Prods.
RCA Manufacturing Co.
Sensitive Research Inst.

**PHASE SEQUENCE INDICATORS**
Associated Research
Cole Instrument
Eastern Specialty Co.
Elec. Facilities Inc.
Ferranti Electric
Fox Valley Inst.
General Elec. Co.
Measurement Corp.
Meter Devices Co.
Sell Electric Co.
Sticht Co.

**Electron-multiplier Photometer**



This unit represents the latest advance in sensitive photometers. Portable detector unit has rotary shutter with five apertures and a dark position. Cabinet contains two complete line-operated stabilized power supplies, a bridge type amplifier and a micro-ammeter calibrated in percent transmission. Controls include (left to right) on-and-off switch, dark-current compensator, sensitivity selector and 100% adjuster.

***SEND FOR BULLETINS***
***on this and other instruments.***

**Ultrasonic Engineering Co.**

P. O. Box 46 Maywood, Illinois

**PHASE SHIFTERS**
Ford Instrument
General Electric
Sperry Gyroscope Co.
States Co.

**PHOSPHATE TESTERS (See Testers & Testing Machines, Phosphate)**

**PHOTOELASTICITY POLARISCOPE (See Polariscope, Photoelasticity)**

**PHOTOELECTRIC CELLS (See Cells, Photoelectric)**

**PHOTOELECTRIC COLOR ANALYZERS (See Color Analyzers, Photoelectric)**

**PHOTOELECTRIC COLOR COMPARATORS (See Color Comparators, Photoelectric)**

**PHOTOELECTRIC CONTROLS**
Audio-Tone Oscillator
Automatic Elec. Chicago
Berkshire Laboratories
Brooke Engineering
Dearborn Scientific
Detect-O-Ray
De-Tec-Tronic Labs.
Eby. Inc.
Electric Eye Equip.
Electric Sorting Mach.
Electronic Prod. Co.
Electro Physics Co.
Engineering Res. & Dev.
Fisher-Pierce Co.
Furst Electronics
General Electric
General Power Plant
Gorrell & Gorrell
Guardian Electric
Hathaway Instrument
Hillyer Inst.
Huggins Labs.
Lumenite Electronic
Madison Elec. Prod.
Marion Electrical Inst.
Martin-Hubbard Corp.
Photoswitch, Inc.
Potter Instrument
Robinette Co.
Rockwell Engr.
Rubicon Co.
Sticht Co.
Westinghouse Elec.
Weston Elec. Inst. Co.
Wilson & Co.
Worner Electronics

**PHOTOGRAMMETRIC INSTRUMENTS**
Abrams Instrument
Aero Electronics
American Paulin Sys.
Bausch & Lomb
Fairchild Camera & Inst.
Hillyer Inst.
Leupold & Stevens
Reed Research
Stratex Instrument Co.
Zeiss, Inc., Carl

**PHOTOGRAPHIC EXPOSURE METERS**
Burke & James
DeJur Amsco Corp.
Dearborn Scientific
General Elec. Co.
G-M Labs.
Hickok Elec. Inst.
Madison Elec. Prod.
Photovolt Corp.
Rockwell Engr.
Roller Smith
Stratex Instrument Co.
Triplett Elec. Inst.
Weston Elec. Inst. Corp.

**PHOTOMETERS, Bar**
Gaertner Scientific Corp.
Leeds & Northrup Co.

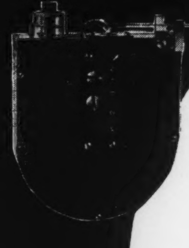
**PHOTOMETERS, Flame**
Baird Associates
Kauffman-Lattimer
La Pine & Co., A. S.
Patwin Inst. Div.
Perkin-Elmer Corp.
Process & Instruments
Scientific Equipment

**PHOTOMETERS, Flicker**
Instrument Dev. Labs.
Leeds & Northrup
Precision Therm.

**PHOTOMETERS, Illumination**
Ansco
DeJur-Amsco Corp
Electro-Tech Equip.
Fish-Schurman Corp.
General Elec. Co.
G. M. Laboratories
Hickok Elect. Inst.
Instrument Dev. Labs.
Leeds & Northrup Co.
Leitz, Inc.
Pfaltz & Bauer, Inc.
Photovolt Corp.
Rockwell Engr.
Triplett Elec. Inst.
Weston Elec. Inst. Co.
Welch Scientific

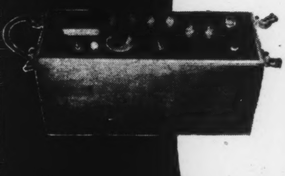
**PHOTOMETERS, Micro (See Densitometers)**

**Edin instruments**



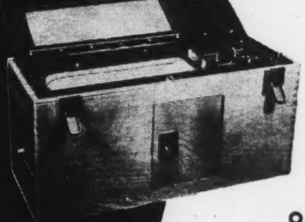
**OSCILLOGRAPH GALVANOMETER**

No's. 8001, 8002, 8003 and 8004 ink-writing galvanometers have sensitivities from 3.5 to 40 volts per cm., resonant frequencies from 15 to 120 cps., resistances from 1000 to 2000 ohms, frequency response up to 350 cps., and a single-jewel pivot construction. Units are designed for multiple operation up to 10 channels in a total width of 12 inches.



**DIRECT-COUPLED AMPLIFIER**

No. 8100 direct coupled amplifier has a voltage amplification of 13,000 with a maximum output of 70 volts. Frequency response from d.c. to 10,000 cps. is flat within 10%. Input impedance is 2 megohms; output impedance is 150 ohms. Input may range from 0.1 mv. to 100 volts. Stability is better than 0.1 mv. per thirty minutes, or 0.5 mv. per day. Attenuator is stepped for factors from 1 to 1000.



**OSCILLOGRAPHS**

Recorders can be supplied with 1, 3 or 9 chart speeds ranging from 0.1 mm./sec. to 250 mm./sec. See specifications of OSCILLOGRAPH GALVANOMETER for frequency range.

**OSCILLOGRAPH AMPLIFIER**

No. 8121 special amplifier has a time constant of 1 second, an exponential response to a square wave at high gain, input impedance of 1 megohm, and input form 0.1 mv. to 1000 volts. At low gain, No. 8121 becomes a DC amplifier with a voltage gain of 100 and an input of 10 mv./mm.

**HIGH-GAIN AMPLIFIER**

No. 8130 amplifier has a voltage gain of 1,000,000 and includes a built-in pre-amplifier. Frequency response is from 1 to 200 cps. Input may range from 10 microvolts to 100 millivolts. This amplifier is particularly suited for Biological studies.

Many other types of recording and amplifier circuits are available and special equipment can be assembled to meet particular specifications.

EDIN COMPANY, INC.
207 Main Street
Worcester 8, Mass.

Please send complete information on:

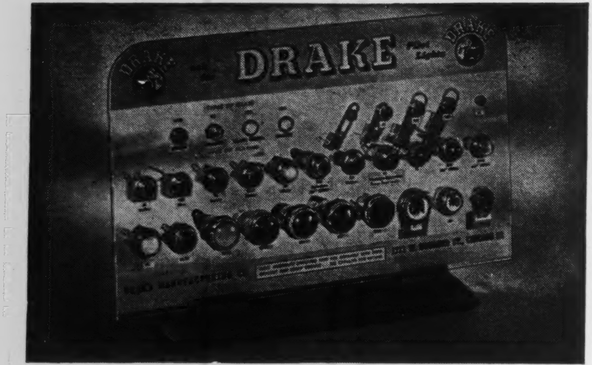
☐ RECORDERS ☐ No. 8100 AMPLIFIER
☐ NO. 8121 AMPLIFIER ☐ No. 8130 AMPLIFIER
☐ GALVANOMETERS ☐ ..........
SPECIAL (Enclose details)

..........
(NAME)

..........
(NO.) (STREET)

..........
(CITY) (STATE)

..........
COMPANY POSITION



LOOK OVER THE BIG DRAKE LINE!

Check all the possibilities offered by this remarkably complete and flexible line—already familiar to most engineers and production men for precision manufacture—low cost—proven performance. The large assortment of popular DRAKE Assemblies shown on this new display board (on view at leading jobbers' everywhere) should give you many a valuable idea for your present and projected equipment. See it at once!

For full data write for Catalog R

DRAKE

SOCKET & JEWEL LIGHT ASSEMBLIES

DRAKE MANUFACTURING CO.
1711 W. HUBBARD STREET • CHICAGO 22

Need PRECISION Potentiometers?
Need SPECIAL Designs?
Need Potentiometer "KNOW-HOW"?

call Helipot

World's largest manufacturer of precision potentiometers!

HELIPOT offers a unique combination of unequalled "know-how", advanced manufacturing facilities and experienced personnel for solving *your particular* problems in the application of precision potentiometers to modern electronic circuits.

Suppliers to both Government and industry, HELIPOT has developed high speed winding, assembling and testing equipment that combine custom-built precision with mass-production economies. Multiple and single-turn designs ... single and double shaft extensions ... ganged assemblies ... custom-spaced taps...multi-turn dials...*these and many other special features are part of the daily output at* HELIPOT!

If you have a problem requiring precision potentiometers, bring it to HELIPOT Corporation—*world leader in its field.* A call or letter outlining your problem will receive immediate attention!

A Typical Example...
This 10-Turn, Model "A" HELIPOT provides a 46" slide wire in only 1¾" dia. panel space. Resistance ranges—10 to 300,000 ohms, power rating, 5 watts. Can be ganged with multiple units per shaft... supplied with custom-spaced taps ... and other special features.
Adaptable to a wide range of applications in experimental, military, industrial and educational fields. Write for data!

REPRESENTATIVES IN ALL PRINCIPAL CITIES
Export Agent: Frathom Co., New York 18, N. Y.

THE Helipot CORPORATION • SOUTH PASADENA 14, CALIFORNIA

**PHOTOMETERS, Neutral Wedge**
American Inst. Co.
Gaertner Scientific Corp.

**PHOTOMETERS, Photoelectric**
Ansco
American Inst. Co.
Applied Research Labs.
Beckman Instruments
Cambridge Inst. Co.
Central Scientific Co.
De Jur Amsco Corp.
Dearborn Scientific
Farrand Optical
Fish Schurman Corp.
Fisher Scientific
Gaertner Scientific Corp.
Gardner Laboratory
General Elec. Co.
G-M Labs.
Hellige, Inc.
Instrument Dev. Labs.
Jarrell-Ash Co.
Klett Mfg. Co.
Meters, Inc.
Parr Instrument Co.
Pfaltz & Bauer, Inc.
Phipps & Bird, Inc.
Phoenix Prec. Inst.
Photovolt Corp.
Rockwell Engr.
Rubicon Co.
Ultrasonic Engr. Co.
Welch Scientific
Weston Elec. Inst. Corp.
Zeiss, Inc., Carl

**PHOTOMETERS, Reflection**
American Inst. Co.
Ansco
Bausch & Lomb Opt.
Beckman Instruments
Farrand Optical
Fish-Schurman Corp.
Gaertner Scientific Corp.
Gardner Laboratory
Instrument Dev. Labs.
Munsell Color Co.
Pfaltz & Bauer
Phoenix Prec. Inst.
Photovolt Corp.
Rubicon Co.

**PHOTOMETERS, Spectro**
Aloe Co., A. S.
American Inst. Co.
Applied Physics Corp.
Baird Associates
Bausch & Lomb Opt.
Biddle Co., James G.
Coleman Instruments
Dietert Co.
Farrand Optical
Gaertner Scientific Corp.
General Elec. Co.
Librascope
Jarrell-Ash Co.
National Tech. Labs.
Perkin-Elmer Corp.
Pfaltz & Bauer, Inc.
Phoenix Prec. Inst.
Process & Instruments

**PHOTOMETERS, Sphere**
Instrument Dev. Lab.
Leeds & Northrup Co.

**PHOTOMETERS, Ultraviolet**
Ansco
Bausch & Lomb Opt.
Beckman Instruments
Burt Scientific Labs.
Farrand Optical
Gaertner Scientific Corp.
General Electric
Jarrell-Ash Co.
Mine Safety App. Co.
Pfaltz & Bauer
Photovolt Corp.
Rubicon Co.

**PHOTO- MICROGRAPHIC EQUIPMENT (See Microscopes, Metallographic)**

**PHYSICAL TESTING MACHINES (See Testers and Testing Machines)**

**PILOT LIGHTS**
Aerolite Electronic
Alden Products
Automatic Electric
Dial Light Co. of Am.
Drake Mfg. Co.
Engineering Assoc.
Gothard Mfg. Co.
Industrial Devices, Inc.
Johnson, E. V.
Littelfuse
Panellit, Inc.
Signal Indicator Co.

**PILOTS, Automatic**
Amer. Electroneering
Eclipse-Pioneer Div.
General Electric Co.
Lear, Inc.
Sperry Gyroscope Co.
Summers Gyroscope

**PICKUPS (See Object of Measurement, e.g. "Vibration," etc.)**

**PIPE LOCATORS**
Aero Electronics
Borden Engineering
Darley Co., W. S.
Detectron Co.
Dillon & Co.
Engineering Labs., Inc.
Fisher Res. Lab.
Geophysical Inst. Co.
Globe Phone Mfg. Co.
Goldak Co.
McFarlin Co.
Municipal Inst.
Water Leak Detector Co.
Western Instrument Co.

M SCOPE

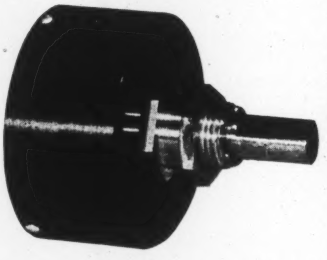
PIPE
AND
CABLE
FINDER
•
Type 49AB

Supplied in Metal Cased Cabinets
$149.50
Weight................10 lbs.
With attachment for
LEAK DETECTION
$197.50
• IMMEDIATE DELIVERY
Send For Free Literature

FISHER
RESEARCH LABORATORY
INCORPORATED
Palo Alto California

-COLE-

Precision Potentiometers



Available in various types and sizes in single and multiple units in linear and non-linear characteristics and in a wide range of resistance values.

Can be supplied to meet extremely close linearity and resistance tolerances, torque, mechanical and electrical rotational and high resolution specifications.

Write us your requirements

COLE Instrument Co.
1320 S. Grand Ave., Los Angeles 15, Calif.

**PIPETTES (See Apparatus, Laboratory, Glass)**

**PIPETTES, Mechanical (Equal Discharge)**
Baltimore Biological Lab.
Distillation Products, Inc.
National Inst.
Scientific Instr. (Calif.)

**PISTOL BARREL OPTICAL TESTERS (See Tester, Pistol Barrel Optical)**

**PITOT - PITOTSTATIC TUBES, Special Aircraft Engine Testing**
Airflo Instrument Co.
Eclipse-Pioneer Div.
Refinery Supply
Revere Corp.
Thermo-Elec. Co.

**PITOT TUBE METERS (See Flow Meters, Pitot Tube)**

**PITOT TUBES (see Flowmeters, Pitot Tube)**

**PLANE TABLES**
Berger & Sons, Inc.
Dietzgen Co.
Eastern Science Co.
Gurley, W. & L. E.
Keuffel & Esser Co.
Speidel & Co.
Warren-Knight Co.
Weber Co.

**PLANIMETERS, Automatic Flow Record**
Builders-Providence
Minneapolis-Honeywell
Robertson, J. L.

**PLANIMETERS, Linear**
Bacharach Indus Inst.
Bruning Co., Inc.
Dietzgen Co.
Keuffel & Esser Co.
Serdex, Inc.
Speidel & Co.
United States Blue Print
Warren-Knight Co.
Weber Co.
White Co., David

**PLANIMETERS, Radial**
Bailey Meter Co.
Foxboro Co.
Keuffel & Esser Co.
Speidel & Co.
Weber & Co.
White Co., David

**PLANIMETERS, Square Root**
American Meter Co.
Bailey Meter Co.
Foxboro Co.
Henschel & Co.
Keuffel & Esser Co.
Speidel & Co.
Taylor Inst. Cos.
Weber & Co.
White Co., David

**PLUMB BOBS**
Alpha Instrument Co.
Brown & Sharpe
Bruning Co., Inc.
Dietzgen Co.
Engis Equipment
Gurley, W. & L. E.
Keuffel & Esser Co.
Leupold & Stevens
Lufkin Rule Co.
Millers Falls Co.
Post Co., Frederick
Refinery Supply Co.
Speidel & Co.
Starrett Co.
Suverkrop Instruments
Ulmer Co., J. C.
Warren-Knight Co.
Weber Co.
White Co., David

**POLARIMETERS**
Bausch & Lomb Opt.
Central Scientific Co.
Fish-Schurman Corp.
Gaertner Scientific Corp.
Jarrell-Ash Co.
Leitz, Inc.
Pfaltz & Bauer, Inc.
Polarizing Instrument
Rudolph & Sons
Sargent & Co.
Zeiss, Inc., Carl

**POLARISCOPE TUBES (See Tubes, Polariscope)**

**POLARISCOPES**
Bausch & Lomb Opt.
Clarkstan Corp.
Gaertner Scientific Corp.
Jarrell-Ash Co.
Optical Service & Dev.
Pfaltz & Bauer, Inc.
Polarizing Instrument
Precision Scientific
Rudolph & Sons
Welch Scientific

**POLARISCOPES, Photoelasticity**
Bausch & Lomb Optical
Central Scientific Co.
Fecker, J. W.
Gaertner Scientific Corp.
Jarrell-Ash Co.
Kollmorgen Optical Co.
M B Mfg. Co.
Polarized Light-Photo Co
Polarizing Instruments
Precision Scientific
Precision Therm.
Zeiss, Inc., Carl

**POLARITY INDICATORS**
Cole Instrument
Ruehfel Co.
Triplett Elec. Inst.
Weston Elec. Inst. Corp.

**POLARIZING PLATES**
Central Scientific Co.
Dearborn Scientific
Polarizing Instrument
Zeiss, Inc., Carl

**POLISHING MACHINES**
American Inst. Co.
Central Scientific
Eimer & Amend
Fisher Scientific Co.
Mico Instrument Co.
Precision Scientific
Schauer Mfg. Co.
Unertl Optical Co.

**POLYGRAPH**
Associated Research
Rutherford Instrument

**PORCELAIN, Laboratory**
Coors Procelain Co.
Dietert Co.
Fish-Schurmann
Laboratory Equip. Corp.
Lapp Insulator
Microchemical Service
Precision Scientific
Sanborn Co.
Thomas Co., Arthur H.
Wheatstone Corp.

**POSITION INDICATORS**
Aero Electronics
Airflo Instrument Co.
Allis-Chalmers
Arma Corporation
Assembly Products
Automatic Temp. Control
Bailey Meter Co.
Barber-Colman
Bendix Marine Products
Boston Auto Gage Co.
Cole Instrument
Eclipse-Pioneer Div.
Electric Speed Ind.
Elec. Tachometer Corp.
Foxboro Co.
General Elec. Co.
Hickok Elec. Inst. Co.
Lear, Inc.
Leupold & Stevens
Martin-Hubbard Corp.
RCA Manufacturing Co.
Republic Flow Meters
Roller-Smith Co.
Schaevitz Engineering
Shallcross Mfg. Co
Sperry Gyroscope Co.
Taylor Inst Cos
Triplett Elec. Inst.
Van Dyke Instruments
Westinghouse Elec.
Weston Elec. Inst. Corp.
Wiancko Engineering

**POSITION RECORDERS**
Aero Electronics
Alden Products
Alfax Paper & Engr.
Annis Co.
Arma Corporation
Autocall Co.
Automatic Elec. Chicago
Bailey Meter Co.
Bristol Co.
Builders-Providence
Cole Instrument
Eclipse-Pioneer Div.
Elec. Indicator Corp.
Elec. Tachometer Corp.
Esterline-Angus Co.
Foxboro Co.
General Electric
Gorrell & Gorrell
Hagan Corp.
Instruments Corp.
Leupold & Stevens
Martin-Hubbard Corp.
RCA Manufacturing
Republic Flow Meters
Servo-Tek Products
Taylor Inst. Cos.
Westinghouse Elec.

**POSTS, BINDING (See Connectors)**

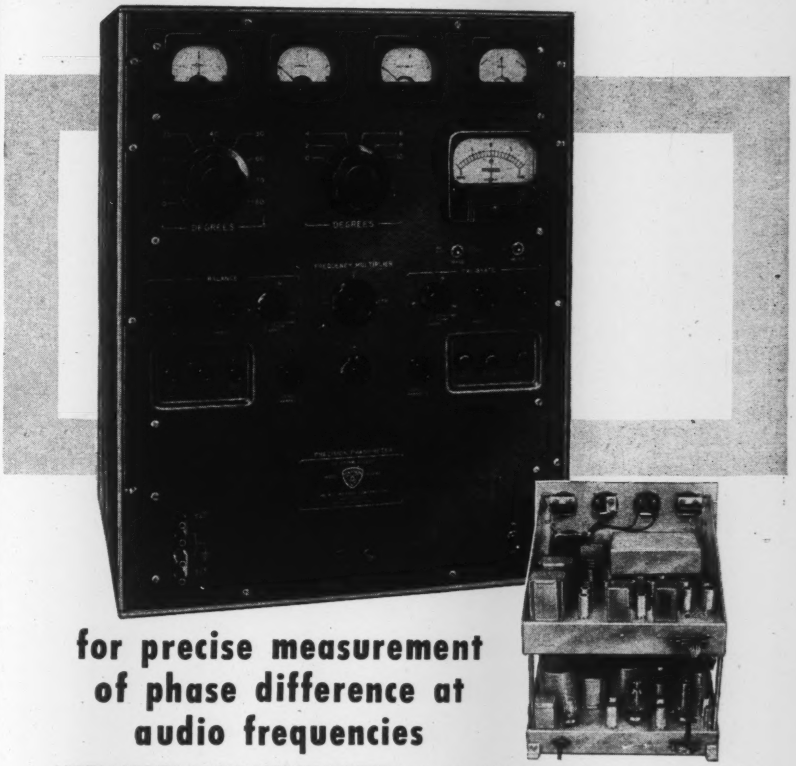
**POTENTIAL DETECTORS (See Detectors, Potential)**

**POTENTIOMETERS, Automatic Control**
Bailey Meter Co.
Bristol Co.
Coleman Elec. Co.
Dickson Co.
Distillation Products
Electro-Mec Lab.
Foxboro Co.
Giannini & Co., G. M.
Gordon Co., Claud S.
Leeds & Northrup Co.
Loudon Insts.
Mason Neilan Regulator
Minneapolis-Honeywell
Schwien Eng. Co.
Spence Engineering Co.
Summers Gyroscope
Tagliabue Div.
Taylor Inst. Co.
Thwing-Albert Co.
Van Dyke Instruments
Weston Elec. Inst. Corp.
Wheelco Inst. Co.
Yardeny Eng.

**POTENTIOMETERS, Automatic Self Balancing**
Bailey Meter Co.
Bristol Co.
Electro-Mec Lab.
Electronic Prod. Co.
Foxboro Co.
General Elec. Co.
Gordon Co., Claud S.
Lear, Inc.
Leeds & Northrup Co.
Minneapolis-Honeywell
Sound Apparatus
Summers Gyroscope

# MAXSON

## PRECISION PHASE METER



**for precise measurement of phase difference at audio frequencies**

**THE MODEL P-1060 PHASE METER** is invaluable wherever precise knowledge of phase relationships in the audio-frequency range must be obtained. It has found increasing acceptance in the design of reactive components or of equipment using them, and in such analytical applications as measurement of residual inductance in "non-inductive" resistors, measurement of stray capacitance across resistors, and investigation of phase relationships in navigational and data-transmission systems.

Employing the phase-comparison method, the instrument exhibits a high degree of accuracy and incremental discrimination. The calibration may be checked with auxiliary equipment available in most laboratories. Even-order harmonic distortion is cancelled and odd-order distortion up to 1% will not affect accuracy of reading.

**SPECIFICATIONS**

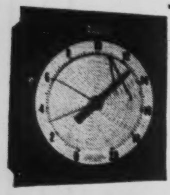
| | |
|---|---|
| Frequency range | 30 to 20,000 cps |
| Phase range | 0 to 360 degrees |
| Accuracy | 0.1 degree |
| Incremental discrimination | 0.01 degree |
| Signal level | 0.5 to 10 volts rms |
| Input impedance | 10 megohms shunted by 25 μ'' |
| Display | Decade null system |
| Output jack | Can be provided for operating external recorder |
| Power requirements | 200 watts at 105-125 volts, 60 cycles |
| Size | 19½" wide, 16¼" deep, 25" high |
| Weight | 110 pounds |
| Cabinet | Internally shielded walnut cabinet. |

**Equipment, when removed from cabinet, is suitable for mounting in standard 19" relay rack.**

**WRITE TODAY for descriptive bulletin 950-IX**

MAXSON

**THE W. L. MAXSON CORPORATION**
460 West 34th Street New York 1, N. Y.



*ElectroniK*

CIRCULAR CHART POTENTIOMETERS

● Compact electronic detecting and balancing unit provides greater accuracy, sensitivity, speed of response and continuous non-cyclic action. Supplied as a thermocouple pyrometer, radiation pyrometer, resistance thermometer, spectrophotometer, millivoltmeter, tachometer, pH meter, and for many laboratory applications. Types of control: pneumatic, mercury switch or vane-type in 21 different control actions.

*ElectroniK* Precision Indicator for centralized readings of up to 48 thermocouple locations. Also available as double scale indicators with two separate measuring systems and an external range change switch. Write for Catalog 15-15.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4579 Wayne Ave., Philadelphia 44, Pa.

MINNEAPOLIS
Honeywell

Brown Instruments

Tagliabue Div.
Weston Elec. Inst. Corp.
Wheelco Inst. Co.
Yardeny Eng.

**POTENTIOMETERS, Indicating**

Bailey Meter Co.
Bristol Co.
Cambridge Inst. Co.
Centralab Div.
Dickson Co.
Distillation Products
Electro-Mec Lab.
Electronic Dev. Lab.
Feiler Engineering
Foxboro Co.
General Elec. Co.
Geophysical Inst. Co.
Giannini & Co.
Gordon Co., Claud S.
Gray Instruments
Hellige, Inc.
J-B-T Insts., Inc.
Leeds & Northrup Co.
Lewis Engg. Co.
Miller, M. C.
Minneapolis-Honeywell
Remler Co., Ltd.
Rowe Enginering
Rubicon Co.
Schwien Eng. Co.

(Continued)

Summers Gyroscope
Tagliabue Div.
Thwing-Albert Instrument
Wheelco Inst. Co.
Weston Elec. Inst. Co.

**POTENTIOMETERS, Recording**

American Inst. Co.
Bailey Meter Co.
Bristol Co.
Clarostat Mfg. Co.
Distillation Products
Edin Electronics
Foxboro Co.
General Electric
Giannini & Co.
Gordon Co., Claud S.
Leeds & Northrup Co.
Loudon Insts.
Mason Neilan Regulator
Minneapolis-Honeywell
Reed Research
Sound Apparatus
Summers Gyroscope
Tagliabue Div.
Thwing-Albert Instrument

**POTENTIOMETERS (Voltage dividers)**

Borg Corp.
Bristol Co.

(Continued)

Brown Electro Meas.
Carter Parts Co.
Centralab Div.
Clarostat Mfg. Co.
Cole Instrument
Daven Co.
De Jur-Amsco Corp.
Electro-Mec Lab.
Electronic Associates
Fairchild Camera
Fieler Engineering
Ford Engineering
Ford Instrument
Foxboro Co.
General Electric Co.
General Radio Co.
Genisco Inc.
Giannini & Co.
Helipot Corp.
Leeds & Northrup
Ohmite Mfg.
International Resistance
Natl. Elec. Controller
Rattray & Co., Geo.
Rex Rheostat
Rubicon Co.
Shallcross Mfg. Co.
Specialties, Inc.
Summers Gyroscope

(Continued)

Technology Inst. Corp.
Thwing-Albert Inst.
Van Dyke Instruments
Ward Leonard Elec. Co.

**POWDERED MATERIALS MEASUREMENTS (See Granular Materials)**

**POWER FACTOR INDICATORS**

Boonton Radio Corp.
Clough-Brengle Co.
Cole Instrument
Elec. Facilities, Inc.
Electronic Instrument
Feiler Engineering
General Elec. Co.
Hickok Elec. Inst. Co.
Leeds & Northrup Co.
Roller-Smith Co.
Sensitive Research Inst.
Triplett Elec. Inst.
Westinghouse Elec.
Weston Electric Inst.

**POWER FACTOR RECORDERS**

Cole Instrument
Elec. Facilities Inc.
Esterline-Angus Co.

(Continued)

General Elec. Co.
Leeds & Northrup Co.
Roller-Smith Co.
Sorenson & Co.
Westinghouse Elec.

**POWER FACTOR REGULATORS**

General Electric Co.
Leeds & Northrup Co.
Modern Controls
Shallcross Controls
Westinghouse Elec.

**POWER-LEVEL INDICATORS**

Amplifier Co.
Audio Instrument
Clough-Brengle Co.
Cole Instrument
Daven Co.
De Jur-Amsco
Electronic Dev. Lab.
Feiler Engineering
General Elec. Co.
General Radio Co.
Hickok Elec. Inst. Co.
Leeds & Northrup
Marion Electrical Inst.
RCA Manufacturing
Reed Research
Sensitive Research Inst.
Shallcross Mfg. Co.
Sound Apparatus Co.
Westinghouse Elec.
Weston Elec. Inst.

**POWER SUPPLIES, REGULATED**

AiResearch Div.
Amer. Electroneering
Applied Science Corp.
Coleman Insts.
Doelcam Corp.
Douglas Radio Labs.
Electronic Instrument
Electro Products Labs.
Electro-Tech Equipment
Engineering Res. & Dev.
Federal Telephone
Furst Electronics
Inductograph Products
Kay Electric
Kepco Laboratories
Laboratory for Electronics
La Marche
Nuclear Inst. & Chemical
Oregon Electronic
Polytechnic Res. & Dev.
Process & Instruments
Richardson-Allen
Schauer Mfg. Co.
Sola Electric Co.
Sorensen & Co.
Southwestern Ind. Elec.
Specialties, Inc.

**PRECISION-BORE GLASS TUBING**

Ace Glass Inc.
Brooks-Rotameter
Corning Glass Works
Crystal Glass Tube
Fischer & Porter
Fish-Schurman Co.
Fredericks Co., Geo.
Kontes Glass Co.
Mercury Glass Co.
Phoenix Prec. Inst.
Podbielniak, Inc.
Porter, George K.
Sampson Chem.
Scientific Glass App.

**PRECISION-BORE METAL TUBING**

Precision Tube Co.

**PRESSES, Laboratory**

American Inst. Co.
Anderson Bros. Mfg. Co.
Baldwin Locomotive
Carver, Fred S.
Central Scientific Co.
Denison Engineering
Emmett Machine
Microchemical Service
Wabash Metal Products
Williams Apparatus

**PRESSES, Pellet**

Black & Webster
Central Scientific Co.
Denison Engineering
Dietert Co.
Eimer & Amend
Hannifin Mfg. Co.
Microchemical Service
Parr Instrument Co.
Precision Scientific
Stokes Machine Co.
Wabash Metal Products

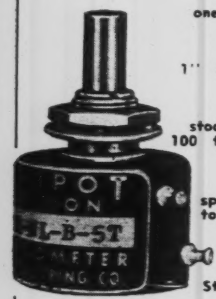
**PRESSURE CONTROLLERS, AUTOMATIC (See Controllers, Automatic, Pressure)**

**PRESSURE, High (Above 1000 lbs.) Indicators**

Aeroquip Corp.
American Mach. & Metal
Acra Regulator, Inc.
Ashton Valve Co.
Atlas Valve Co.
Automatic Temp. Control
Bailey Meter Co.
Baldwin-Lima-Hamilton
Bristol Co.

(Continued)

FORD
MULTIPOT
Helical Type
wire wound precision
POTENTIOMETERS



one to ten turns

1'' and 1½'' dia.

stock resistances
100 to 100,000 ohms

special resistances
to 350,000 ohms

Three
Standard Types

Furnished with or without Linearity Guarantee to—.05%

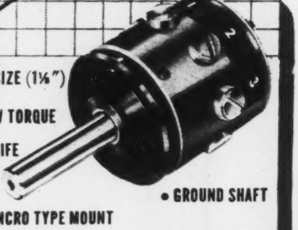
Unconditional Guarantee

*Prompt Shipment most types*

Send for our Catalog No. 8

FORD ENGINEERING CO.
Upland, California

SYNCROMOUNT
POTENTIOMETER



- SMALL SIZE (1⅛")
- LOW TORQUE
- LONG LIFE
- GROUND SHAFT
- SYNCRO TYPE MOUNT
- LINEAR OUTPUT
- FUNCTIONAL OUTPUT

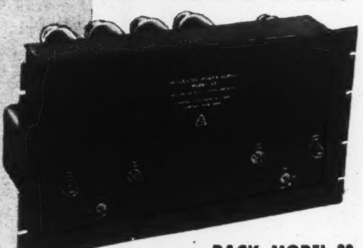
Giannini, standard with the leaders, develops this small ballbearing potentiometer with a variety of unique features to meet the latest computer requirements. Runout and concentricity within .001 in. Total resistance up to 100,000 ohms, torque less than 0.2 inch ounces.

*For details on this and other instruments write:*

G. M. GIANNINI & CO., INC.
PASADENA 1, CALIFORNIA

giannini

ELECTRONICALLY REGULATED
LABORATORY
POWER SUPPLIES



RACK MODEL 32

STABLE
DEPENDABLE
MODERATELY PRICED

STANDARD RACK MOUNTING
PANEL SIZE 10½" x 19"
DEPTH 9"
WEIGHT 38 LBS

- INPUT: 105 to 125 VAC, 50-60 cy
- OUTPUT #1: 200 to 325 VDC at 300 ma regulated
- OUTPUT #2: 6.3 Volts AC CT at 5A unregulated
- OUTPUT #3: 6.3 Volts AC CT at 5A unregulated
- RIPPLE OUTPUT: Less than 10 millivolts rms

For complete information write for Bulletin N-2X

λ LAMBDA ELECTRONICS CORPORATION
CORONA NEW YORK

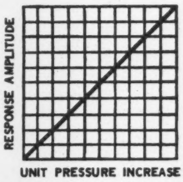
**NEW**

**Linear Stabilized**

**PRESSUREGRAPH**

**MEASURES & RECORDS EXPLOSION, GAS or HYDRAULIC PRESSURE**

**For Jet or Internal Combustion Engines, Compressors, Pipe Lines, Injection Pumps and Explosions**
Completely Re-engineered, it now provides greater accuracy in measuring and recording pressure-time studies of dynamic, static and transient pressure phenomena. In addition to its wide range (from a few ounces to 10,000 PSI) and broad frequency response (static or zero to over 20,000 CPS) it offers these new exclusive features:



**Linear measurement. Drift stabilized. Temperature stabilized. 200,000 separate pressure measurements per second. Up to 200' of pick-up cable can be used. Greatly simplified adjustments on pick-up.**

**DYNAMIC MICROMETER**

***Measures Dynamic or Static Displacement, Vibration or Movement of Any Metal Body Without Physical Contact***

**Only accurate measurement for static or dynamic displacement due to eccentricity, axial vibration, radial whip, bearing clearance, radial expansion with acceleration and reciprocating movement. Measurements are independent of acceleration or speed of rotation.**

***Let Our Sales Engineers Help You***

**Electro**
ELECTRONIC EQUIPMENT

**ELECTRO PRODUCTS LABORATORIES**
**4503-LD Ravenswood Ave., Chicago 40, Illinois**

Brooke Eng. Co.
Clark Cooper Co.
Cook Electric
Crosby Steam Gage
Electro Prod. Lab
Electronics Products Co.
Elematic Equip. Corp.
Emery Co., A. H.
Fisher Governor Co.
Flader, Inc., Frederic
Foxboro Co.
Gotham Inst. Co.
Hays Corp.
Heise Bourdon Tube Co.
Kollsman Inst. Co.
Leeds & Northrup
Linde Air Products Co.
Manning, Maxwell & Moore
Mansfield & Green
Marsh Corp.
Marshalltown Mfg.
Mason Neilan Regulator
McAlear Mfg. Co.
Minneapolis-Honeywell
Parks Co., Harry S.
RCA Manufacturing Co.
Republic Flow Meters
Ruska Inst. Corp.
Rutishauser Corp.
Sheffield Corp.
Star Brass Mfg. Co.
Statham Labs
Tagliabue Div.
Taylor Inst. Cos.
Thrush & Co., H. A.
Trerice Co
U. S. Gauge
Weksler Thermometer
Wheelco Instruments
Wiancko Engineering

### PRESSURE, HIGH (Above 1000 lbs.) Recorders

Aeroquip Corp.
American Inst. Co.
Annis Co.
Automatic Temp. Control
Bailey Meter Co.
Baldwin-Lima-Hamilton
Bristol Co.
Builders-Providence
Cambridge Inst. Co.
Cash Co.
Clark Cooper Co.
Commercial Research
Cook Electric
Crosby Steam Gage Co.
Dickson Co.
Emery Co., A. H.
Esterline-Angus Co.
Flader, Inc., Fredric
Foxboro Co.
Gotham Inst. Co.
Hathaway Inst. Co.
Hays Corp.
Leeds & Northrup
Linde Air Products Co.
Manning, Maxwell & Moore
Mason-Neilan Regulator
Minneapolis-Honeywell
Parks Co., Harry S.
Penn Ind. Instrument
Republic Flow Meters Co.
Sheffield Corp.
Statham Labs.
Tagliabue Div.
Taylor Inst. Cos.
Trerice Co.
U. S. Gauge Co.
Weksler Thermometer
Wheelco Instruments

### PRESSURE, HIGH (Above 1000 lbs.) Testing Devices

American Inst. Co.
Ashton Valve Co.
Bailey Meter Co.
Baldwin-Lima-Hamilton
Builders-Providence
Carver, Fred S.
Cook Electric
Crosby Steam Gage Co.
Dillon & Co.
Electro Products Labs.
Flader, Inc., Fredric
Foxboro Co.
Hathaway Inst. Co.
Hawk Tool & Eng.
Manning, Maxwell & Moore
Marsh Corp.
Martin-Hubbard Corp.
Minneapolis-Honeywell
Parks Co., Harry S.
Parr Instrument Co.
Penn Ind. Inst. Co.
Pioneer Instrument
RCA Manufacturing Co.
Refinery Supply Co.
Sheffield Corp.
Trerice Co.

### PRESSURE INDICATORS, Bellows

Aeromarine Inst. Co.
Autocall Co.
Automatic Temp. Control
Bailey Meter Co.
Barton Inst. Co.
Bridgeport Thermostat
Bristol Co.
Cook Electric Co.
Crosby Steam Gage Co.
Defender Inst. & Reg.
Dickson Co.
Emery Co., A. H.
Engineering Res. & Dev.
Foxboro Corp.
Giannini & Co.
Gotham Inst. Co.
Hays Corp.
Manning, Maxwell & Moore
Marshalltown Mfg.
Mason-Neilan Regulator
Panellit, Inc.
Perfex Corp.
Precision Therm.
Republic Flow Meters
Shallcross Controls

(Continued)

**BOOTH TEST UNITS**

***For Fast, Low-Cost Work in Field and Laboratory***

**Power Supply**

Booth Power Supplies provide two electrically isolated and separately controlled output circuits smoothly adjustable from zero to maximum range with vernier control. Ideal for checking both single and double coil a-c and d-c instruments, meters and many other types of electrical equipment. Portable and bench types.

***Write for complete folder.***

AEB

**ARTHUR E. BOOTH COMPANY**
***Electrical Testing Apparatus***
4124 Beverly Blvd. Los Angeles 4, Calif.

*Measuring and control units plug in.*

**MILLIVOLTMETER PYROMETERS**
**Indicating Controllers**

**PYR-O-VANE.** This inexpensive temperature controller combines a high-resistance galvanometer with a vane-type electronic control unit. Provides fine line control with snap action at control point. Available with a variety of control forms. Send for Specification Sheet No. 112.

**PROTECT-O-VANE.** Excess temperature cut-off controller, provides positive protection for furnaces and payloads. Has complete "fail-safe" protection. Manual reset push-button restarts process only after temperature drops to safe limit. Send for Specification Sheet No. 113.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division,* 4579 Wayne Ave., Philadelphia 44, Pa.

MINNEAPOLIS **Honeywell**
Brown Instruments

Summers Gyroscope
Tagliabue Div.
Taylor Inst. Cos
Trerice Co.
U. S. Gauge
Wallace & Tiernan
Weksler Thermometer

**PRESSURE INDICATORS, Bourdon-tube see Gages, Bourdon**

**PRESSURE INDICATORS, Diaphrams, etc.**
Aeromarine Inst. Co.
Automatic Temp. Control
Bailey Meter Co.
Cook Electric
Dickson Co.
Eclipse-Pioneer Div.
Electro Products Labs
Emery Co., A. H.
Engineering Res. & Dev.
Foxboro Co.
Gotham Inst. Co.
Hays Corp.
Kollsman Inst. Div.
Manning, Maxwell & Moore
Marsh Corp., Jas. P.
Marshalltown Mfg.
Mason-Neilan Regulator
Moore Products
Perfex Corp.
Photocon Research
Powers Regulator Co.
Republic Flow Meters
Rochester Mfg. Co.
Ruska Inst. Corp.
Rutishauser Corp.
Shallcross Controls
Sheffield Corp.
Sperry Gyroscope Co.
Summers Gyroscope
Taglibue Div.
Taylor Inst. Cos.
Trerice Co.
Trimount Inst. Co.
U. S. Gauge
Viking Instruments

**PRESSURE INDICATORS, Electrical resistance**
Aeroquip Corp.
Baldwin-Lima-Hamilton
Cole Instrument
Cook Electric
Electro Products Lab.
Engineering Res. & Dev.
Flader, Inc., Fredric
Foxboro Co.
General Elec. Co.
Hathaway Instrument
Minneapolis-Honeywell
Rubicon Co.
Shallcross Controls
Sheffield Corp.
Skaneateles Mfg. Co.
Statham Labs.
Trimount Inst. Co.
U. S. Gauge Co.

**PRESSURE INDICATORS, Inverted-bell**
Automatic Temp. Control
Bacharach Indus. Inst.
Bailey Meter Co.
Bristol Co.
Defender Inst. & Reg.
Dickson Co.
Foxboro Co.
Hays Corp.
Magnetrol Inc.
Mason-Neilan Regulator
Minneapolis-Honeywell
Republic Flow Meters
Shallcross Controls
Taylor Inst. Cos.
Uehling Inst. Co.

**PRESSURE INDICATORS, Membrane**
Aeromarine Inst. Co.
Hays Corp.
Perfex Corp.
Taylor Instrument Cos.

**PRESSURE INDICATORS, Piezoelectric**
Brush Development Co.
Commercial Research
Crystal Research Labs.
Gulton Mfg.
Martin-Hubbard Corp.
Massa Labs.
RCA Manufacturing

(Continued)

**PRESSURE INDICATORS, Piston, Weight-loaded**
American Inst. Co.
Bailey Meter Co.
Coleman Inst. & Mfg.
Hagan Corp.
Mansfield & Green
Republic Flow Meters
Ruska & Co.

**PRESSURE INDICATORS, Single-tube, liquid column**
Bacharach Indus. Inst.
Dwyer Mfg. Co.
Electronic Products Co.
Gas App. Specialties
Ideal Lab. Tool
Manning, Maxwell & Moore
Meriam Instrument
Parks Co., Harry S.
Precision Therm.
Uehling Instrument Co.

**PRESSURE INDICATORS, Spring-loaded pisten**
Bacharach Indus. Inst.
Commercial Research
Mansfield & Green

**PRESSURE INDICATORS, U-tube**
American Meter Co.
Amthor Test. Mach.
Automatic Temp. Control
Bacharach Indus. Inst.
Bailey Meter Co.
Connelly Iron Sponge
Defender Inst. & Reg.
Dwyer Mfg. Co.
Electronics Products Co.
Friez Instrument Div.
Gas App. Specialties
Gotham Inst. Co.
Hays Corp.
Ideal Lab. Tool
Manning, Maxwell & Moore
Mason-Neilan Regulator
Meriam Instrument
Moeller Instrument Co.
Parks Co., Harry S.
Precision Therm.
Refinery Supply Co.
Ruska Inst. Corp.
Tagliabue Div.
Taylor Inst. Cos.
Trerice Co.
Trimount Inst. Co.
Uehling Instrument Co.
Vapor Recovery System

**PRESSURE PICKUPS, Electrical, Magnetic, etc.**
Altec Lansing
Brush Development
Clarkstan Corp.
Control Engrg. Corp.
Electro Products Labs.
Electronic Eng. Assoc.
Flader, Fred
Hart Associates
M B Mfg. Co.
Midwestern Geophysical
Monarch Radio & TV
Pickering & Co.
Radio Corp. of Am.
Rahm Instruments Inc.
Servomechanisms Inc.
Southwestern Ind. Elec.
Sperry Products
Valpey Crystals

**PRESSURE RECORDERS, Bellows**
Automatic Temp. Control
American Meter Co.
Bailey Meter Co.
Bridgeport Thermostat
Bristol Co.
Cook Electric
Crosby Steam Gauge
Defender Inst. & Reg.
Dickson Co.
Engineering Res. & Dev.
Esterline-Angus Co.
Flader Inc., Fredric
Foxboro Co.
Gorrell & Gorrell
Gotham Inst. Co.
Hays Corp.
Manning, Maxwell & Moore
Mason-Neilan Regulator
Minneapolis-Honeywell

(Continued)

Penn Ind. Inst. Corp.
Powers Regulator
Republic Flow Meters
Summers Gyroscope
Tagliabue Div.
Taller & Cooper
Taylor Inst. Cos.
Weksler Thermometer

**PRESSURE RECORDERS, Bourdon tube**
Automatic Temp. Control
American Meter Co.
Bailey Meter Co.
Baldwin Locomotive
Bristol Co.
Builders-Providence
Crosby Steam Gauge
Defender Inst. & Reg.
Dickson Co.
Esterline-Angus Co.
Foxboro Co.
**Giannini & Co.**
Gordon Co., Claud S.
Gotham Inst. Co.
Hays Corp.
Improved Gauge Mfg. Co.
Kahl Scientific Inst.
Kenyon Instrument Co.
Leeds & Northrup Co.
Manning, Maxwell & Moore
Marsh Corp., Jas. P.
Mason-Nielan Regulator
Moeller Inst. Co.
Penn Ind. Inst. Corp.
Powers Regulator
Republic Flow Meters
Summers Gyroscope
Tagliabue Div.
Taylor Inst. Cos.
Thrush & Co., H. A.
Trerice Co.
U. S. Gauge
Weksler Thermometer

**PRESSURE RECORDERS, Capsular spring**
Automatic Temp. Control
Cook Electric
Manning, Maxwell & Moore
Penn Ind. Inst. Co.
Republic Flow Meters
Tagliabue Div.

**PRESSURE RECORDERS, Diaphram**
Automatic Temp. Control
Bailey Motor Co.
Bristol Co.
Cook Electric
Defender Inst. & Reg.
Dickson Co.
Engineering Res. & Dev.
Foxboro Co
**Giannini & Co.**
Gotham Inst. Co.
Hays Corp.
Manning, Maxwell & Moore
Marsh Corp., Jas. P.
Mason-Neilan Regulator
Penn Ind. Inst. Corp.
Powers Regulator
Republic Flow Meters
Sanborn Co.
Sheffield Corp.
Tagliabue Div.
Taylor Inst. Co.
Wheelco Instruments

**PRESSURE RECORDERS, Electrical-resistance**
Aeroquip Corp.
Baldwin-Lima-Hamilton
Cole Instrument
**Engineering Res. & Dev.**
Flader Inc., Fredrie
Giannini & Co.
**Hathaway Instrument**
Heiland Research
Minneapolis-Honeywell
Republic Flow Meters
Sheffield Corp.
Statham Labs.
Summers Gyroscope
Trimount Inst. Co.
Yellow Springs Inst. Co.

**PRESSURE RECORDERS, Inverted-bell**
**American Meter Co.**
Automatic Temp. Control
Bacharach Indus. Inst.
Bailey Meter Co.
Bristol Co.
Dickson Co.
Foxboro Co.

(Continued)

Hays Corp.
Leeds & Northrup Co.
Mason-Neilan Regulator
Penn Ind. Inst. Corp.
Republic Flow Meters
Taylor Inst. Cos.
Uehling Instrument Co.

**PRESSURE RECORDERS, Membrane**
Bailey Meter Co.
Defender Inst. & Reg.
Hays Corp.
Mason-Neilan Regulator
Republic Flow Meters
Taylor Inst. Cos.

**PRESSURE RECORDERS, Piezolectric**
Brush Development Co.
Massa Labs.
RCA Manufacturing Co.

**PRESSURE RECORDERS, Piston, weight-loaded**
Bailey Meter Co.

**PRESSURE RECORDERS, Single-tube liquid column**
Trerice Co.
Uehling Instrument Co.

**PRESSURE RECORDERS, Spring-loaded piston**
Bacharach Indus. Inst.
Baldwin-Lima-Hamilton
Commercial Research
Hays Corp.

**PRESSURE RECORDERS, U-tube**
Automatic Temp. Control
Bailey Meter Co.
Fielden Instrument
Foxboro Co.
Gorrell & Gorrell
Hays Corp.
Manning, Maxwell & Moore
Mason-Neilan Regulator
Minneapolis-Honeywell
Penn Ind. Inst. Co.
Republic Flow Meters
Tagliabue Div.
Taylor Inst. Cos.
Trerice Co.
Uehling Instrument Co.

**PRESSURE SNUBBERS**
American Meter Co.
Ashton Valve Co.
Brown Inst. Div.
Campell Co., J. A.
Fischer & Porter
Manning, Maxwell & Moore
Mansfield & Green
Marsh Corp.
Martin Decker Corp.
McAlear Mfg. Co.
Meriam Instrument
Metal Goods Corp.
Micro Metallic Corp.
National Engg. Products
Parker Appliance

**PRISMS**
Alpha Instrument Co.
American Optical
Bausch & Lomb Opt.
Binswanger & Co.
Boehmke Optical Co.
Bray Optical
Buchele Optical Co.
Cadillac Glass Co.
Cal-Astro Optical Labs.
Clark & Sons
Curtiss Labs.
Dearborn Scientific
Eclipse-Pioneer Div.
Electro-Physics
Engis Equipment
Fish-Schurman Co.
Fecker, J. W.
Gaertner Scientific Corp.
Geophysical Inst. Co.
Glendale Optical
Goerz Amer. Optical Co.
Hayward Scientific Glass
Henson Co., Fred C.
Herron Optical
Ice Optical Co., H. C.
International Glass
Jarrell-Ash Co.
Keuffel & Esser Co.
Kollmorgen Optical Co.

(Continued)

Lancaster Lens
**Machlett & Son**
Mann Co., W. I.
Optron Laboratory
Pacific Optical
Palos Optical Co.
Penn Optical & Inst.
Perkin-Elmer Corp
Plummer & Kershaw
Robinson Optical
Schneider-Cogswell
Simpson Optical
Tinsley Labs.
Univis Lens Co.
Valpey Crystals

**PROBES (See Object of Measurement, e.g. "Vibration," etc.)**

**PROBES, TEST, High Potential**
Electronic Instrument
Electro-Tech Equipment
Feiler Engineering

**PROCESS TIMING INSTRUMENTS (See Timers, Automatic Process)**

**PROFILE-RECORDERS. Roughness Waviness, etc.**
Automatic Temp. Control
Brush Development
Industrial Electronics
Physicists Research Co.
Sheffield Corp.

**PROGRAM CLOCKS (See Timers, Automatic Process)**

**PROJECTORS, Color Film**
American Optical
Bausch & Lomb Optical
Bell & Howell Co.
Bolsey Corp.
Bray Optical Co.
De Vry Corp.
Dome Precision
Eastman Kodak Co.
General Biological
G-M Laboratories
Leitz, Inc.
Lovins Engr.
RCA

**PROJECTORS, Film Slides, Lantern Slide & Opaque Object**
Aloe Co., A. S.
American Meas. Insts.
American Optical
Bausch & Lomb Optical
Bell & Howell Co.
Beseler Co., Charles
Bolsey **Corp.**
Burton Mfg. Co.
DeVry Corp.
Dome Precision
Eastman Kodak Co.
Fish-Schurman Corp.
General Biological
G-M Laboratories
Leitz, Inc.
Pflatz & Bauer
Stocker & Yale
Zeiss, Inc.

**PROJECTORS, Industrial Inspection**
American Optical
Bausch & Lomb
Beseler, Co., Charles
Dorothea Mechanisms, Gale
Engineers' Specialties Div.
Engis Equipment
Sheffield Corp.
Stocker & Yale
Unertl Optical
Wilder Inc.

**PROJECTORS, Oscillogram**
Consolidated Engr.
Radioactive Products
Telecomputing Corp.

**PROJECTORS, Rectifying**
Abrams Instrument

**PRONY BRAKES, Hydraulic**
Taylor Dynamometer

**PROPORTIONING PUMPS See Pumps, Metering and Proportioning)**

**PROTRACTORS, Bevel (See Drawing Instruments)**

**PROTRACTORS, Course**
Alpha Instrument Co.
Bliss & Co.
Instrumaster Industries
Kenyon Instrument Co.
Keuffel & Esser Co.
Marine Compass Co.
Negus, T. S. & J. D.
Warren-Knight Co.

**PROTRACTORS, Navigator's (See Protractors, Course)**

**PROTRACTORS, Transparrent (See Drawing Instruments)**

**PROVERS, Gas Meter**
American Meter Co.
Precision Scientific
Superior Meter Co.

**PROVING RINGS**
Baldwin-Lima-Hamilton
Olsen Testing Machine
Pittsburgh Inst. & Mech.
Steel City Test. Mach.

**PSYCHOLOGY LABORATORY APPARATUS**
Brush Development Co.
Electro-Medical Lab.
Electro-Physics Co.
General Radio Co.
Gorrell & Gorrell

(Continued)

Martin-Hubbard Corp.
**Phipps & Bird, Inc.**
**Stoelting Co., C. H.**

**PSYCHROMETERS, Aspiration**
Friez Instrument Div.
G. M. Mfg. Co., Inc.
Gotham Instrument
Green, Henry J.
H-B Inst. Co.
Instruments Corp.
Johnson Service Co.
Kahl Scientific Inst.
Mason-Neilan Regulator
Minneapolis-Honeywell
Moeller Instrument Co.
Powers Regulator

**PSYCHROMETERS, Electric (See Psychrometers, Aspiration)**

**PSYCHROMETERS, Recording (See Hygrometers, Recording)**

**PSYCHROMETERS, Sling**
Accuracy Scientific Inst.
American Inst. Co.
American Moistening Co.
Central Scientific Co.
Chicago Apparatus Co.
Ever Ready Thermometer
Foxboro Co.
Friez Instrument Div.
G. M. Mfg. Co., Inc.
Green, Henry J.
H-B Inst. Co.
Huddleston, J. S. F.
Instruments Corp.
Johnson Service Co.
Kahl Scientific Inst.
Laboratory Specialties
Mine Safety App. Co.
Moeller Instrument Co.
Palmer Co.
Phila Thermometer Co.
Precision Scientific
Precision Thermometer
Scientific Inst. Co.
Taylor Inst. Cos.
Trerice Co.
Warren-Knight Co.
Weksler Thermometer

**PUBLIC HEALTH TESTING EQUIPMENT**
Aloe Co., A. S.
American Scientific Co.
Central Scientific Co.
Chicago Apparatus Co.
Corning Glass Works
Electric Hotpack Co.
Electric Scientific Co.
General Biological
Hellige, Inc.
LaMotte Chemical Prod.
Menlo Research Lab.
Phipps & Bird
Photovolt Corp.
Precision Scientific Co.
R-C Scientific Inst.
Rieker Inst. Co.
Rubicon Co.
Scientific Glass App.
Taylor & Co., W. A.

**PULSATION DAMPER (See Pressure Snubber)**

**PULVERIZED MATERIALS MEASUREMENTS (See Granular Materials)**

**PUMPS, Compressed Air (See Air Compressors)**

**PUMPS, High Vacuum**
Central Scientific Co.
Chicago Appratus Co.
Dennison Eng. Co.
Distillation Prods., Inc.
Eclipse-Pioneer Div.
Eitel-McCullough, Inc.
Electronic Products
Fredericks Co., Geo.
Kontes Glass Co.
Machlett & Son
National Research Corp.
Phoenix Prec. Inst.
Precision Scientific
Refinery Supply Co.
Scientific Glass App.
Sterling Eng. Co.
Stoelting Co., C. H.
Stokes Machine Co.
Uehling Inst. Co.
Universal X-Ray Prods.
Welch Scientific

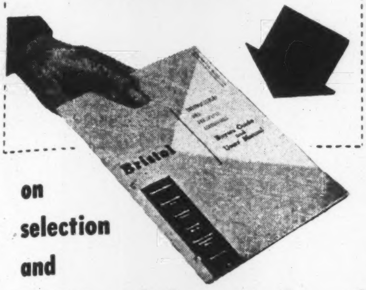
**PUMPS, Hydraulic Control**
Adel Precisiion Prods.
Barnes Co., W. F. & J.
Dusenbury Co.
Eastern Industries, Inc.
Eclipse-Pioneer Div.
Ingersoll-Rand
Lapp Insulator
Precision Scientific
Skaneateles Mfg. Co.
Sundstrand Machine Tool

**PUMPS, Laboratory High Pressure (25,000 PSI)**
American Instrument
Hills-McCanna
Milton Roy Co.
Proportioneers Inc.
Ruska Inst. Corp.
Specialties Inc.

**PUMPS, Metering and Proportioning**
Baltimore Biological Lab.
Bowser, Inc.
Gelber Co., Samual S.
Hills-McCanna
Ingersoll-Rand
Lapp Insulator
Milton Roy Co.
Neptune Pump
Process & Instruments
Proportioneers Inc.
Ruska Inst. Corp.

NEW . . . FREE . . .

ENGINEERING HANDBOOK

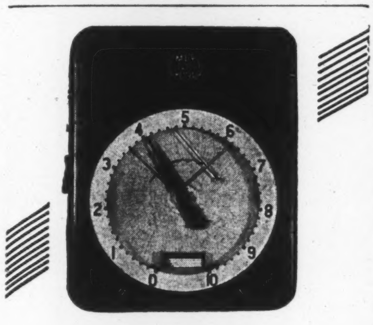


on selection and application of thermocouples and pyrometer accessories

Complete, easy-to-use compilation of Bristol's line of modern thermocouples and pyrometer accessories . . . tables and charts useful in quickly selecting the right thermocouple and protection tube . . . illustrations of typical applications . . . tables of calibration data . . . PLUS a conveniently indexed and carefully illustrated catalog of the complete Bristol line of thermocouples, extension wire, protection tubes, insulators and accessories.

Write for your free copy of this 56-page Pyrometer Guide.

THE BRISTOL COMPANY
113 BRISTOL RD., WATERBURY 20, CONN.



BAILEY

*Electronic Pyrometer*

● This indicating, recording, and controlling BAILEY PYROTRON is a self balancing potentiometer which records one or two temperatures continuously on a 12-inch diameter chart and indicates on a 29-inch bold scale. It may be furnished with air-operated, electric, or electronic control.

A thermocouple or radiation unit is the temperature sensitive element.

Minimum maintenance is insured by elimination of galvanometers, millivolt meters, and continuously moving or vibrating mechanisms. A reversible electric motor under electronic control, balances the potentiometer network and drives the indicating, recording and controlling features.

Bailey Pyrotron Recorder-Controllers are made up of interchangeable assemblies, standardized so that only a few spare parts need be carried in stock to provide replacements for many instruments. Ask for Bulletin 232.

BAILEY METER COMPANY
1041 IVANHOE ROAD · CLEVELAND, O.
Bailey Meter Company Ltd. Montreal, Canada

**PYCNOMETERS**
Coleman Inst. & Mfg.
Eimer & Amend
Fisher Scientific Co.
G. M. Mfg. Co.
Humboldt Mfg. Co.
Leeds & Northrup
Pyrometer Inst. Co.
Rascher & Betzold
Scientific Glass App.
Specialty Glass Co.

**PYRHELIOMETERS**
Cambridge Inst. Co.
Eppley Lab.
G. M. Mfg. Co.
Kahl Sci. Inst. Co.
Leeds & Northrup Co.
Pyrometer Inst. Co.

**PYROMETER CALIBRATING SETS**
Bristol Co.
Brown Inst. Div.
Cambridge Inst. Co.
DeJur-Amsco
Foxboro Co.
Illinois Testing Labs.
Leeds & Northrup Co.
Lewis Engineering
Pyrometer Inst. Co.
Rubicon Co.
Taco West Corp.
Tagliabue Div.
Thwing Albert Inst. Co.
Wheelco Inst. Co.
Winslow Co.

**PYROMETERS, Electrical Resistance**
Assembly Products
Bailey Meter Co.
Bristol Co.
Cambridge Inst. Co.
Cole Instrument
Dickson Co.
Electric Hotpack Co.
Engelhard, Chas.
Ferner Co.
Foxboro Co.
General Elec. Co.
Gordon Co., Claud S.
Gray Instrument
Ill. Tesing Labs.
J-B-T Inst., Inc.
Leeds & Northrup Co.
Lewis Engg. Co.
Loudon Insts.
Minneapolis-Honeywell
Phen-Trols, Inc.
Pyrometer Inst. Co.
Roller-Smith Co.
Rubicon Co.
Taco West Corp.
Tagliabue Div.
Thwing-Albert Inst. Co.
Wheelco Inst. Co.
Winslow Co.

**PYROMETERS, Expansion**
Burling Instrument Co.
Defender Inst. & Reg.
Ferner Co.
Lewis Engineering
Partlow Corp.
Pyrometer Inst. Co.
Tagliabue Div.
Thwing Albert Inst. Co.
Wheelco Insts. Co.

**PYROMETERS, Indicating**
Assembly Products
Bacharach Indus. Inst.
Bailey Meter Co.
Bristol Co.
Burling Inst. Co.
Burrell Tech. Supply
Cole Instrument
Defender Inst. & Reg.
DeJur-Amsco
Electric Hotpack Co.
Electronic Prod. Co.
Elematic Equip. Corp.
Engelhard, Chas.
Foxboro Co.
General Electric
Gordon Co., Claud S.
Gray Instrument
Ill. Testing Labs.
J-B-T Instruments
Leeds & Northrup Co.
Lewis Engg. Co.
Marshall Co., L. H.
Meters, Inc.
Minneapolis-Honeywell
Partlow Corp.
Pyramid Instrument Co.
Pyrometer Inst. Co.
Richards Co., Arkely S.
Roller-Smith Co.
Rubicon Co.
Taco West Corp.
Tagliabue Div.
Tamms Silica Co.
Taylor Inst. Cos.
Thermo Electric Co.
Thwing-Albert Instrument
Wheelco Inst. Co.
Winslow Co.

**PYROMETER, Millivoltmetric**
Assembly Products
Beede Elec. Inst.
Bristol Co.
Cambridge Inst. Co.
Cole Instrument
De Jur-Amsco Corp.
Elematic Equip Corp
Engelhard, Chas.
Foxboro Co.
General Elec. Co.
Gordon Co., Claud S.
Gray Instrument
Ill. Testing Labs.
J-B-T Instruments
Lewis Engr. Co.
Marion Electrical Inst.
Meters, Inc.
Minneapolis-Honeywell
Pyramid Instrument Co.
Pyrometer Inst. Co.

(Continued)

Richards Co., Arkley S.
Roller-Smith Co.
Rubicon Co.
Sensitive Research Inst
Taco West Corp
Tamms Silica Co.
Taylor Inst. Cos.
Thermo Electrio Co.
Thwing-Albert Instrument
Wheelco Inst. Co.
Winslow Co.

**PYROMETERS, Optical**
Bacharach Indus. Inst.
Burrell Technical Supply
Cambridge Inst. Co
Dietert Co
Electro-Tech Equip
Fisher Scientific Co
Gordon Co., Claud S.
Instrument Dev. Labs.
Leeds & Northrup Co.
Lewis Engineering
Minneapolis-Honeywell
Pyrometer Inst. Co.

**PYROMETERS, Portable**
Assembly Products
Bacharach Indus. Inst.
Bristol Co.
Burrell Technical Supply
Cambridge Inst. Co.
Cole Instrument
De Jur-Amsco
Electro-Tech Equip.
Elematic Equip. Corp.
Engelhard, Chas.
Ferner Co.
Foxboro Co.
Gordon Co., Claud S.
Gray Instrument
Ill. Testing Labs.
Instrument Lab., Inc.
J-B-T Instruments
Leeds & Northrup Co.
Lewis Engg. Co.
Meters, Inc.
Pyrometer Inst. Co.
Pyrometer Service Co.
Richards Co., Arkley S.
Roller-Smith
Rubicon Co.
Tagliabue Div.
Tamms Silica Co.
Thwing-Albert Instrument
Wheelco Instrument
Winslow Co.

**PYROMETERS, Potentiometric**
Bailey Meter Co.
Bristol Co.
Cambridge Inst. Co.
De Jur-Amsco
Dickson Co.
Foxboro Co.
General Electric
Gordon Co., Claud S.
Gray Engg. Co.
Leeds & Northrup
Lewis Engg. Co.
Loudon Insts.
Minneapolis-Honeywell
Pyrometer Inst. Co.
Rubicon Co.
Tagliabue Div.
Thwing-Albert Instrument
Wheelco Inst. Co.

**PYROMETERS, Radiation, Controlling**
Bacharach Indust. Inst.
Bailey Meter Co.
Bristol Co.
Cambridge Inst. Co.
Engelhard, Chas.
Foxboro Co.
General Elec. Co.
Gordon Co., Claud S.
Ill. Testing Labs.
Leeds & Northrup Co.
Minneapolis-Honeywell
Pyrometer Inst. Co.
Thwing-Albert Instrument
Wheelco Inst. Co.

**PYROMETERS, Radiation, Indicating**
Bacharach Indust. Inst.
Bristol Co.
Cambridge Inst. Co.
General Elec. Co.
Leeds & Northrup Co.
Lewis Engineering
Minneapolis-Honeywell
Pyrometer Inst. Co.
Thwing-Albert Instrument
Wheelco Inst. Co.

**PYROMETERS, Radiation, Recording**
Bacharach Indust. Inst.
Bailey Meter Co.
Bristol Co.
Cambridge Inst. Co.
General Elec. Co.
Gordon Co., Claud S.
Leeds & Northrup Co.
Minneapolis-Honeywell
Pyrometer Inst. Co.
Thwing-Albert Instrument

**PYROMETERS, Thermoelectric, Immersion**
Bailey Meter Co.
Bristol Co.
Burling Inst. Co.
Cambridge Inst. Co.
Cole Instrument
De Jur-Amsco
Elematic Equip. Corp.
Engelhard, Chas.
Ferner Co.
Foxboro Co.
General Elec. Co.
Gordon Co., Claud S.
Gray Instrument
Illinois Testing Labs.
J-B-T Instruments., Inc
Leeds & Northrup Co.
Lewis Engg. Co.
Marshall Co., L. H.
Meters, Inc.

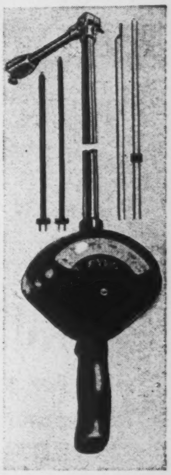
(Continued)

PYRO —FOR PRECISION TEMPERATURE MEASUREMENTS

The Simplified PYRO OPTICAL is the only self-contained, direct reading, accurate and dependable unit for quick and accurate high temperature measurements. Unique construction permits determinations even on **Minute Spots, Fast Moving Objects** or of the **Smallest Streams. Special Foundry Type** and **Universal Triple Range** have additional Red Scale for direct readings of the true spout and pouring temperatures of molten iron, steel, monel, etc., when measured in the open.

**Stock Ranges from 1400°F to 7500°F**

**Write for Catalog #80**

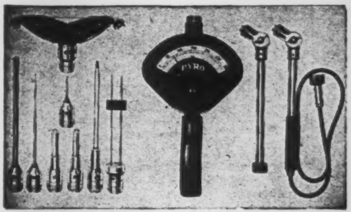


The NEW PYRO IMMERSION represents the acme of ruggedness, accuracy and dependability and is **Indispensable** in any Modern non-ferrous Foundry.

Constructed in a shock, moisture and dust-proofed shielded steel housing, it is immune to external magnetic influences and will withstand the roughest handling. "Bare metal" and "Protected" type thermocouples instantly interchangeable. Other features include the new, large 4¾" direct reading indicator, automatic cold end junction compensator and lock swivel.

**Models available from 0-1000° F to 0-2500° F**

**Our Catalog #150 will interest you**

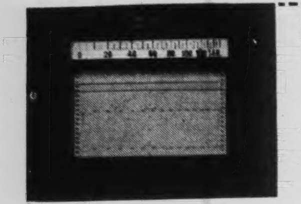


The NEW PYRO all-purpose Surface Pyrometer has been designed to meet all plant and laboratory surface and sub-surface temperature measurement requirements. Available in five temperature ranges from 0-300°F to 0-1200°F with a selection of eight types of interchangeable thermocouples and two extension arms. Also features automatic internal cold end junction compensator, shock, moisture and dust-proofed shielded steel housing.

Write for Catalog #165

THE PYROMETER INSTRUMENT CO.
Plant & Laboratory
Bergenfield 4, New Jersey

In Canada, Sales and Repair Laboratory:
Dominion Flow Meter Company Limited
Toronto and Montreal



*Electronik*

STRIP CHART POTENTIOMETERS

• Continuous balance electronic measuring circuit provides high accuracy, sensitivity and speed of response. Available for from 1 to 16 records with 4½, 12 or 24 seconds full scale pen travel on 12" chart. Chart speeds changeable between 1 and 120 inches per hour. Also available in single and double index types, with double, single and triple section charts. Control may be electric contact, proportional or pneumatic. Auxiliary mercury switches for various switching actions can be supplied on many models. Write for Catalog 15-15.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4579 Wayne Ave., Phila. 44, Pa.

MINNEAPOLIS

Honeywell

*Brown Instruments*

Partlow Corp.
Pyrometer Inst. Co.
Pyrometer Service Co.
Revere Corp.
Richards Co., Arkley S.
Roller-Smith
Rubicon Co.
Taco West Corp.
Tagliabue Div.
Thwing-Albert Instrument
Wheelco Instruments
Winslow Co.

**PYROMETERS, Thermo-electric, Indicating**

Airflow Instrument
Alden Products
Altax Paper & Engg.
Assembly Products
Bailey Meter Co.
Bristol Co.
Cambridge Inst. Co.
Cole Instrument.
DeJur-Amsco Corp.
Electro-Tech Equip.
Elmatic Equip. Corp.
Engelhard, Chas.
Feiler Engineering
Ferner Co.
Foxboro Co.
General Electric

(Continued)

Gordon Co., Claud S.
Gray Instrument
Hebler Co.
Huppert Co., K. H.
Ill. Testing Labs.
J-B-T Instruments, Inc.
Leeds & Northrup Co.
Lewis Engg. Co.
Meters, Inc.
Minneapolis-Honeywell
Partlow Corp.
Pyrometer Inst. Co.
Revere Corp.
Richards Co., Arkley S.
Roller-Smith
Rubicon Co.
Scientific Inst. Co.
Taco West, Corp.
Tagliabue Div.
Taylor Inst. Cos.
Thermo Electric Co.
Thwing-Albert Instrument
Wabash Metal Products
Wheelco Inst. Co.
Winslow Co.

**PYROMETERS, Thermo-electric, Recording & Controlling**

Assembly Products
Bacharach Indust. Inst.

(Continued)

PYROMETERS

For Measuring

Temperatures To 4000° F.

**Bristol Dynamaster Electronic Potentiometer Continuous-Balance Fast-Speed Instrument.**

The Bristol line of pyrometers includes potentiometer, millivoltmeter, thermocouple and radiation types.
Automatic Pyrometer Controllers are available with any of the following types of control: Electric, Electronic, or Air-Operated.
A wide variety of temperature ranges and models are offered to fill most every industrial application.

Write for Bulletins P1200, P1242, P1244, and PB1237.

NEW FREE HANDBOOK ON THERMOCOUPLES

Write also for new combination handbook and catalog on thermocouples, tubes and accessories, P1238.

THE BRISTOL COMPANY
113 BRISTOL RD., WATERBURY 20, CONN.

Bailey Meter Co.
Beck Co.
Bristol Co.
Cambridge Inst. Co.
Cole Instrument
Engelhard, Chas.
Feiler Engineering
Foxboro Co.
General Elec. Co.
Gordon Co., Claud S.
Ill. Testing Labs.
Instrument Dev. Labs.
Leeds & Northrup Co.
Lewis Engg. Co.
Loudon Insts.
Mason-Neilan Regulator
Minneapolis-Honeywell
Partlow Corp.
Pyrometer Inst. Co.
Richards Co., Arkley S.
Taco West Corp.
Tagliabue Div.
Thwing-Albert Instrument
Wheelco Instruments

**PYROMETERS, Thermo-electric, Suface Contact**

Bailey Meter Co.
Bristol Co.
Cambridge Inst. Co.
Cole Instrument
Elematic Equip. Corp.
Englehard, Chas.
Feiler Engineering
Ferner Co.
Foxboro Co.
General Elec. Co.
Gordon Co., Claud S.
Gray Instrument
Huppert Co., K. H.
Illinois Testing Labs.
J-B-T Instruments
Laboratory Specialties
Lewis Engg Co.
Pyrometer Inst. Co.
Pyrometer Service Co.
Revere Corp.
Taco West Corp.
Tagliabue Div.
Tamms Silica Co.
Thwing-Albert Instrument
Wheelco Instruments
Winslow Co.

**PYROMETERIC CONES (See Cones, Pyrometric.)**

**Q METERS**

Boonton Radio
Electro-Tech Equip.
Freed Transformer
General Electric Co.
Technology Instrument
United Transformer

**QUARTZ, Fused Quartz Apparatus (see Apparatus, Laboratory, Fused Quartz**

**RADAR TRANSMITTERS AND MODULATORS**

Amer. Electroneering
Laboratory for Electronics
Lavoie Labs.
Sperry Gyroscope Co.

**RADIOACTIVITY DETECTING AND MEASURING EQUIPMENT**

Abrams Instrument
Berkeley Scientific
Clarkstan Corp.
Cole Instrument
Detectron Co.
Douglas Radio Labs.
General Electric
Georator Corp.
Kelley-Koett Inst. Div.
Loudon Insts.
Lovins Engr.
MacDonald Co., W. S.
Menlo Research Lab.
Nuclear Dev. Lab.
Nuclear Inst. & Chem.
Nuclear Res. & Dev.
Nucleonic Corp.
Potter Instrument
Radiation Counter Labs.
Radioactive Products
R-C Scientific Inst.
Special Instruments Lab.
Stratex Instrument Co.

(Continued)

Technical Associates
Tracerlab
Western Radiation Lab.
Weston Elec. Inst.
Wood Counterlab

**RADIOACTIVITY STANDARDS (See Standards, Radioactivity**

**RADIO ACTIVITY MEASURING INSTRUMENTS**

Berkeley Scientific
Canadian Radium
Cyclotron Specialties
Geo hysical Inst. Div.
Herbach & Rademan
Instrument Div. Labs.
Martin-Hubbard Corp.
Radiation Counter Lab.
Sylvania Electric
Technical Associates
Tracerlab, Inc.
Victoreen Inst. Co.

**RADIO BEACON SYNCHRONIZING CONTROLLERS**

Beacon Gage Co.
Federal Telephone Co.
Islip Radio Mfg.
Radio Receptor Co.
Wallace & Tiernan

**RADIO FREQUENCY Meters**

Aero Instrument
Burlington Inst. Co.
Clough-Brengle Co.
Dale Instruments
De Jur-Amsco
Electronic Div. Lab.
Electro Products Lab.
Feiler Engineering
Ferris Inst. Corp.
General Elec. Co.
General Radio Co.
Hewlett-Packard
Hickok Elec. Inst. Co.
Kay Electric
Lampkin Laboratories
Measurement Corp.
Meters, Inc.
Miller Mfg. Co.
National Co.
Potter Instrument
Premier Crystal Labs.
Rawson Electrical Inst.
RCA Div.
Roller-Smith
Sensitive Research Inst.
Simpson Elec. Co.
Sherron Metallic
Sperry Gyroscope Co.
Triplett Electrical Inst.
Walkirt Co.
Westinghouse Elec.
Weston Elec. Inst. Corp.

**RADIO FREQUENCY OSCILLATORS (See Oscillators, Radio Frequency)**

**RADIO-MICROMETERS (Sss Micrometers, Radio)**

**RADIO REMOTE CONTROL SYSTEMS (See Controller Automatic, Radio Remote)**

**RADIO SET ANALYZERS (See Analyzers, Radio Set)**

**RADIOSONDES**

Alden Products
Applied Science Corp.
Friez Instrument Div.
General Elec. Co.
Kollsman Inst. Div.
Reiner Electronics
Serdex, Inc.
Wallace & Tiernan

**RADIO TUBE CHECKERS (See Analyzers, Radio Set)**

**RADIUM DETECTORS see Detectors, Radioactivity**

**RADIUM HANDLING EQUIPMENT**

Radiation Counter Labs.
Western Radiation Lab.

**RAIN GAGES**

Ballauf Mfg. Co
Central Scientific Co.
Friez Instrument Div.
Green, Henry J.
Gurley, W. & L. E.
Henson Co., Fred C.
Instruments Corp.
Keuffel & Esser Co.
Leupold & Stevens
Precision Thermometer
Stewart, M. C.
Taylor Inst. Cos.
Warren-Knight Co.
White Co., Inc.

**RAINFALL RECORDERS**

Friez Instrument Div.
Gorrell & Gorrell
Green, Henry J.
Instruments Corp.
Leupold & Stevens
Taylor Inst. Cos.

**RANGE FINDING INSTRUMENTS**

Bauch & Lomb
Farrand Optical
Fecker, J. W.
Fisher Research Corp.
Gartner Scientific Corp.
Hastings Inst. Co.
Keuffel & Esser Co.
Kollmorgen Optical Co.
Leitz, Inc.
Precision Thermometer
RCA Manufacturing
Stafford Co.
White Co., Inc.

**RANGE POLES (See Surveying Instruments)**

**REACTANCE METERS**

Clarke Inst. Corp.
Electro Products Lab.
Freed Transformer
General Elec. Co.
General Radio Co.
Premier Crystal Labs.
RCA Manufacturing
Rubicon Co.
Sensitive Research Inst.

**REACTIVE VOLT-AMPERE METRES, See Volt-ampere Meters, Reactive**

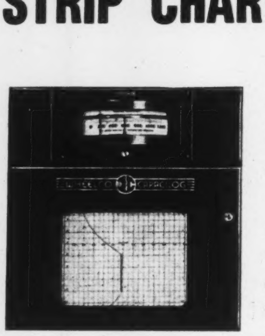
**READING LENSES, Thermomenter & Burette (See Lenses, Reading)**

**RECORDER, Magnetic Tape**

Ampex Electric
Brush Development

(Continued)

instrumentality

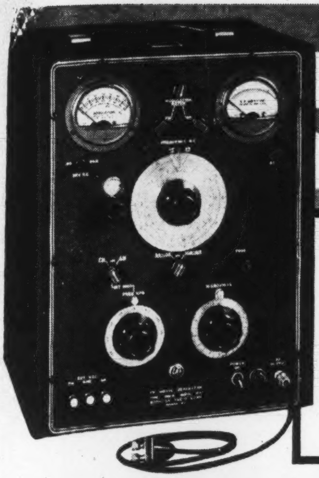


STRIP CHART RECORDER

for measurement, indication, control and permanent record!

Specify the Wheelco CAPACILOG — for fast, simple, precise and economical permanent recording — plus indication and control of temperature (-300°F to 3600°F), speed, static strain loads, AC or DC voltage, amperage and other electrically measurable factors. Get Wheelco instru*mentality* in action—ask for Condensed Catalog. Wheelco Instruments Company, 843 W. Harrison St., Chicago 7, Illinois.

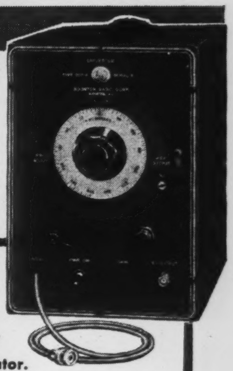
wheelco *electronic controls*



# PRECISION MEASURING INSTRUMENTS FOR THE RADIO AND ELECTRONIC INDUSTRY

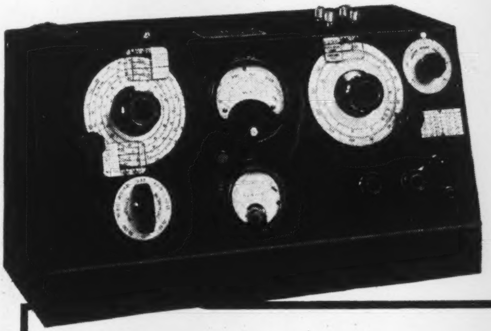
## FM SIGNAL GENERATOR *TYPE 202-B*

RF COVERAGE: 54—216 megacycles in two ranges; accuracy ± 0.5%.
FM DEVIATION: Three ranges, 0—24 kc., 0—80 kc., 0—240 kc., continuously adjustable.
FM DISTORTION: Less than 2% at 75 kc. deviation.
AMPLITUDE MODULATION: One range, 0—50%; calibrations at 30% and 50% modulation.
INTERNAL MODULATING FREQUENCIES: Eight frequencies from 50 cycles to 15 kc.
RF OUTPUT: 0.1 microvolt to 0.2 volt, continuously adjustable by means of 26.5 ohm piston type attenuator.



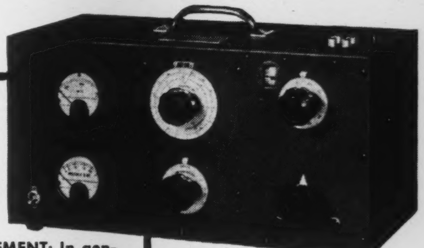
## UNIVERTER *TYPE 207-A*

An FM-AM frequency converter accessory with unity gain for use with 202-B FM Signal Generator.
RF RANGE: 0.1 mc. to 55 mc.
RF INCREMENT DIAL: ±300 kc. in 5 kc. increments.
RF OUTPUT: 0.1 microvolt to 0.1 volt, calibrated output (26.5 ohms); 1.5 volts max., uncalibrated output (approx. 330 ohms).



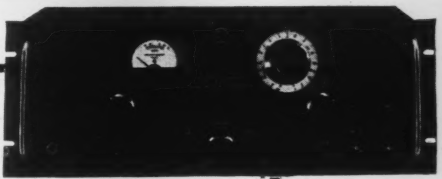
## Q-METER *TYPE 160-A*

FREQUENCY RANGE: 50 kc. to 75 mc. (± 1%, 50 kc.—50 mc.; ± 3%, 50 mc.—75 mc.). May be extended down to 1 kc. with external accessory oscillator.
RANGE OF Q MEASUREMENTS, COILS: 50—625.
ACCURACY OF Q MEASUREMENT: In general, ± 5%.
RANGE OF Q TUNING CAPACITOR: Main Section, 30—450 mmf. (± 1% or ± 1 mmf., whichever is greater). Vernier Section, plus 3, zero, minus 3 mmf., (± 0.1 mmf.).



## Q-METER *TYPE 170-A*

FREQUENCY RANGE: 30 mc. to 200 mc. (± 1%).
RANGE OF Q MEASUREMENT: 80—1200.
ACCURACY OF Q MEASUREMENT: In general, ± 10%.
RANGE OF Q TUNING CAPACITOR: 11—60 mmf. (± 1% or ± 0.5 mmf., whichever is greater).



## GLIDE SLOPE TEST SET—*TYPE 212-A*

For use with Type 211-A Signal Generator to test Glide Slope Receivers.
RF FREQUENCY RANGE: 329 mc. to 335 mc.
Output: Same as 211-A ± 1 db—Variations in output for constant input indicated.
Output Impedance: 53 ohms unbalanced.
IF FREQUENCIES: 20.700 mc., 20.400 mc., 21.000 mc. crystal controlled.
Output: 1 microvolt to 1 volt across 53 ohms unbalanced.
AM Modulation available.

### OMNI RANGE

## SIGNAL GENERATOR

*TYPE 211-A*

FREQUENCY RANGE: 88-140 megacycles in one range. Also two crystal controlled frequencies: 110.100 and 114.900 mc., each accurate to ± 0.0035%.
AMPLITUDE MODULATION: Two ranges, 0-30% and 0-100%. Fidelity ± 0.5 db., 30 cycles to 11 kc.
INTERNAL AUDIO OSCILLATOR: Two modulating frequencies, 400 and 1000 cycles.
PHASE DISTORTION: Less than 0.25 degrees at 30 cycles up to 60% AM.
OUTPUT VOLTAGE: 0.2 volts maximum across 26.5 ohms.

*Write for further information*

BRC

**BOONTON RADIO** *Corporation*
BOONTON·N·J·U·S·A

SANBORN

1, 2 and 4 channel

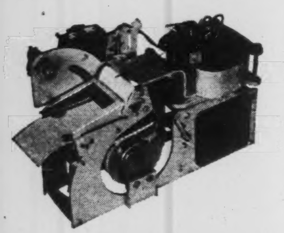
RECORDING SYSTEMS

DIRECT WRITING — NO INK

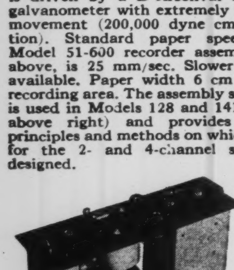
RECTANGULAR COORDINATES

PERMANENT RECORDS

RECORDERS AND AMPLIFIERS AVAILABLE SEPARATELY

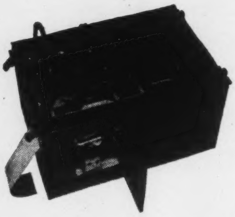


In all Sanborn recorders, tracings are produced by a heated writing stylus in contact with heat sensitive, plastic-coated paper. The paper is pulled over a sharp edge in the paper drive mechanism, and the stylus wipes along this edge as it swings; thus producing records in true rectangular coordinates. The writing arm is driven by a D'Arsonval moving coil galvanometer with extremely high torque movement (200,000 dyne cm/cm deflection). Standard paper speed for the Model 51-600 recorder assembly, shown above, is 25 mm/sec. Slower speeds are available. Paper width 6 cm with 5 cm recording area. The assembly shown above is used in Models 128 and 141 (described above right) and provides the basic principles and methods on which recorders for the 2- and 4-channel systems are designed.



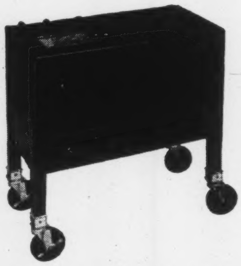
Two types of amplifiers are available for use in Sanborn recording systems — a DC General Purpose Amplifier, and a Strain Gage amplifier (shown above). The amplifiers used in the 2- and 4-channel systems are generally identical with those in the 1-channel system, which are available, as are also all the recorders, for separate application.

1 CHANNEL RECORDING SYSTEMS



**Model 128** comprises a DC General Purpose Amplifier in combination with the Recorder Assembly shown below left, to which is added panel, transformer, and controls. Both instruments are contained in a single hardwood carrying case. The complete system is a vacuum tube recording voltmeter capable of reproducing in rectangular coordinates any electrical phenomena from the order of a few millivolts to more than 200 volts. When a Strain Gage Amplifier is specified, the system becomes Model 141. Amplifiers are readily interchangeable. When a built-in timer is included for either, the Model numbers become 128T or 141T.

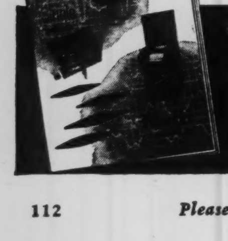
2 CHANNEL RECORDING SYSTEMS



The two channels of **Model 60** operate independently of each other, but record simultaneously. Ten paper speeds are standard equipment, in pairs of: 5 and 0.5, 10 and 1, 25 and 2.5, 50 and 5, 100 and 10 mm/sec. Ready interchangeability of amplifiers (DC and Strain Gage) and preamplifiers (DC and AC) makes possible the availability of a variety of input circuits. Timing and coding are built-in features. Each channel has a 5 cm recording width.

4 CHANNEL RECORDING SYSTEMS

**Model 67** provides for the direct, simultaneous registration of up to four phenomena on one record, using the same principles and methods as the two systems described above. In addition, there is a selection of eight paper speeds: 50, 25, 10, 5, 2.5, 1.0, 0.5, and 0.25 mm/sec., and provision for the use of 4-, 2-, or 1-channel recording Permapaper. As in Model 60, above, amplifiers and preamplifiers are readily interchangeable.



*For complete descriptions, illustrations, tables of constants, and prices, write for catalog.*

INDUSTRIAL DIVISION
Sanborn Company
CAMBRIDGE 39, MASSACHUSETTS

Fairchild Recording
Magnecard, Inc.
Presto Recording
R.C.A.

**RECORDERS (See object of measurment and control)**

**RECTIFIERS, Dry Disk**
Automatic Elec. Chicago
Birtcher Corp.
Bradley Labs.
Conant Laboratories
Control Corp.
Dearborn Scientific
De Jur-Amsco Corp.
Elec. Facilities, Inc.
Federal Telephone
General Elec. Co.
International Rectifier Corp.
La Marche
Mallory & Co.
Radio Receptor Co.
Raytheon Mfg. Co.
Richardson-Allen
Schauer Mfg. Co.
Standard Elec. Time
Standard Transformer
Sylvania Elec. Prod.
Vickers Electric
Westinghouse Elec.

**RECTIFIERS, Mercury Vapor**
Eitel McCullough
Federal Telephone

**RECTIFIERS, Power**
Airdesign, Inc.
Allis-Chalmers
American Communications
American Transformer
Amplifier Co.
Applied Research Labs.
Automatic Elec.
Birtcher Corp.
Bradley Labs.
Continental Electric
Cutler-Hammer, Inc.
Eclipse Aviation
Eitel McCullough
Elec. Facilities Inc.
Electro Products Labs.
Electronic Labs. Inc.
Electronic Products
Electrons, Inc.
Electro-Tech Equip.
Federal Telephone
Furst Electronics
General Elec. Co.
Huggins Labs.
Mallory & Co.
Raytheon Mfg. Co.
RCA
Richardson-Allen
Schauer Mfg. Co.
Vickers Electric
Westinghouse Elec.

**RECTIFIERS, Thermionic**
American Communications
Amplifier Co.
Atomic Instrument
Automatic Elec. Chicago
Birtcher Corp.
Communication Meas. Lab.
Continental Elec. Co.
Dearborn Scientific
DuMont Labs., Inc., A. B.
Electro Products Labs.
Electronic Products
Electrons, Inc.
Federal Telephone
Furst Electronics
General Elec. Co.
Process & Instruments
Raytheon Mfg. Co.
RCA Division
Richardson-Allen
Sylvania Elec. Prod.

**REDUCING MOTIONS, ENGINE INDICATOR**
Bacharach Indust. Inst.
Crosby Steam Gage Co.
Trimount Inst. Co.

**REFLECTIONMETERS (See Reflectometer)**

**REFLECTOMETERS**
American Inst. Co.
Beckman Instruments
Dearborn Scientific
Fish-Schurman Corp.
Gardner Laboratory
General Electric
Instrument Dev. Labs.
Leeds & Northrup Co.
Pfaltz & Bauer
Photovolt Corp.

**REFLECTORS, Aspherical**
American Lens Co.
Baird Associates
Bausch & Lomb Optical
Buchele, W.
Fecker, J. W .
Fish-Schurman Co.
Geophysical Inst. Co.
Howland Optical
Ice Optical Co., H. C.
Lancaster Lens
Mann Co., W. I.
Optron Laboratory
Palos Optical Co.
Perkin-Elmer Corp.
Simpson Optical Mfg.
Tinsley Labs.
Unertl Optical Co.
Zenith Optical

**REFLECTORS, Concave**
American Lens Co.
Baird Associates
Bausch & Lomb Optical
Bray Optical
Buchele, W.
Cal-Astro Optical
Clark & Sons
Curtiss Labs.
Dome Precision
E & S Optical

(Continued)

Eclipse-Pioneer
Fecker, J. W.
Fish-Schurman Co.
Gaertner Scientific
Geophysical Inst. Co.
Hayward Scientific Glass
Henson Co., Fred C.
Herron Optical
Howland Optical Co.
Ice Optical Co., H. C.
International Glass
Lancaster Lens
Mann Co., W. I.
Optron Laboratory
Pacific Optical
Palos Optical Co.
Penn Optical & Inst.
Perkin-Elmer Corp.
Simpson Optical Mfg.
Tinsley Labs.
Unertl Optical Co.
Zenith Optical

**REFLECTORS, First Surface**
American Lens
Baird Associates
Bausch & Lomb Optical
Bray Optical Co.
Buchele, W.
Cal-Astro Optical
Clark & Sons
Crystal Research Labs.
Curtiss Labs.
Dearborn Scientific
Dome Precision
E & S Optical
Fecker, J. W.
Fish-Schurman Co.
Gaertner Scientific
Geophysical Instrument
Hayward Scientific Glass
Henson Co., Fred C.
Herron Optical
Howland Optical Co.
Ice Optical Co., H. C.
International Glass
Laboratory Specialties
Lancaster Lens
Mann Co., W. I.
Optron Laboratory
Pacific Optical
Pacific Univ. Prod.
Palos Optical Co.
Penn Optical & Inst.
Perkin-Elmer Corp.
Simpson Optical Mfg.
Tinsley Labs.
Unertl Optical Co.
Zenith Optical

**REFLECTORS, Heat Resisting**
American Lens
Bausch & Lomb Optical
Fecker, J. W.
Fish-Schurman Co.
Lancaster Lens
Mann Co., W. I.
Optron Laboratory
Palos Optical Co.
Perkin-Elmer Corp.
Simpson Optical Mfg.
Zenith Optical

**REFLECTORS, Parabolic**
American Lens
Baird Associates
Bausch & Lomb Optical
Buchele, W.
Clark & Sons
Farrand Optical
Fecker, J. W.
Fish-Schurman Co.
Gaertner Scientific
Howland Optical Co.
Ice Optical Co., H. C.
Lancaster Lens
Mann Co., W. I.
Optron Laboratory
Palos Optical Co.
Perkin-Elmer Corp.
Simpson Optical Mfg.
Tinsley Labs.
Unertl Optical Co.
Weber Bros. Metal Works
Zenith Optical

**REFLECTORS, Spherical**
American Lens
Baird Associates
Bausch & Lomb Optical
Bray Optical
Buchele, W.
Cal-Astro Optical
Curtiss Labs.
E & S Optical
Farrand Optical
Fecker, J. W.
Fish-Schurman Co.
Gaertner Scientific
Geophysical Inst. Co.
Hayward Scientific Glass
Henson Co., Fred C.
Herron Optical
Howland Optical Co.
Ice Optical Co., H. C.
International Glass
Lancaster Lens
Mann Co., W. I.
Optron Laboratory
Pacific Optical
Palos Optical Co.
Penn Optical & Inst.
Perkin-Elmer Corp.
Simpson Optical Mfg.
Tinsley Labs.
Unertl Optical Co.
Zenith Optical

**REFLECTORS, Stellite**
Acme Industrial
Bausch & Lomb Optical
Gaertner Scientific
Geophysical Inst. Co.
Kollmorgen Optical Co.
Mann Co., W. I.
Optron Laboratory
Perkin-Elmer Corp.
Zenith Optical

WORLD'S
MOST POPULAR
PROFESSIONAL TAPE RECORDERS

# *Magnecorders*

**FIRST FOR FIDELITY**

Specialized magnetic tape recording equipment for every instrument use. Subsonic to supersonic recording range. Models immediately available with 50-15,000 cps.

**FIRST FOR FLEXIBILITY**

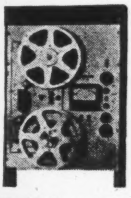
Exclusive Magnecord unit construction lets you use Magnecord recorders, amplifiers, and other units interchangeably for portable, rack, or console—add other units at will—record from one to four microphones.

**FIRST FOR FEATURES**

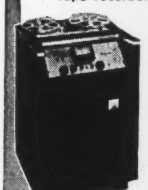
Now 3 separate heads permit monitoring from tape. Three speeds: 15, 7½, 3¾ inches per second. Up to one hour on 7" NAB reels—will take 10½" reels on portable, too. New POSITIVE TIMING DRIVE. Can be remotely controlled.

**THERE'S A MAGNECORDER FOR EVERY PURPOSE . . . . . . EVERY PURSE**

See the PT6-A portable — only $300. World's most widely used professional tape recorder.



PT7, PT63, and PT6 also rack mount.



PT7 Console — $950 complete

See your distributor or write for specifications on PT6, PT63, and PT7 series Magnecorders.

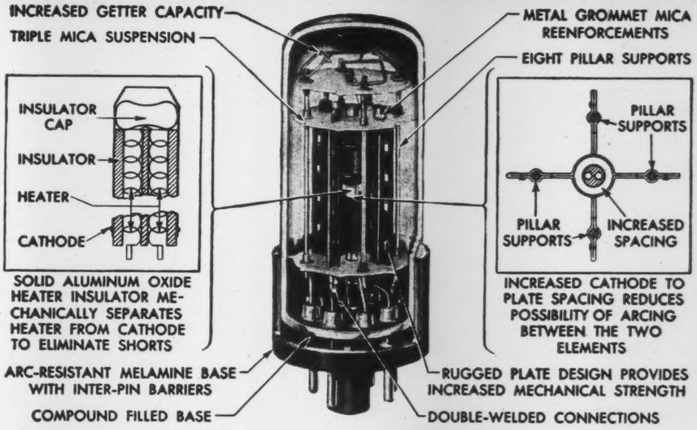
**Magnecord INC.**

360 North Michigan Avenue
Chicago 1, Illinois

---

# RECTIFIER TUBES

## RUGGEDIZED BY
## ECLIPSE-PIONEER
## FOR ADDED RELIABILITY


INCREASED GETTER CAPACITY
TRIPLE MICA SUSPENSION
METAL GROMMET MICA REENFORCEMENTS
EIGHT PILLAR SUPPORTS
INSULATOR CAP
INSULATOR
HEATER
CATHODE
SOLID ALUMINUM OXIDE HEATER INSULATOR MECHANICALLY SEPARATES HEATER FROM CATHODE TO ELIMINATE SHORTS
PILLAR SUPPORTS
PILLAR SUPPORTS
INCREASED SPACING
INCREASED CATHODE TO PLATE SPACING REDUCES POSSIBILITY OF ARCING BETWEEN THE TWO ELEMENTS
ARC-RESISTANT MELAMINE BASE WITH INTER-PIN BARRIERS
COMPOUND FILLED BASE
RUGGED PLATE DESIGN PROVIDES INCREASED MECHANICAL STRENGTH
DOUBLE-WELDED CONNECTIONS

We are not in the standard vacuum tube business, but we are in the business of developing and manufacturing a reliable line of special purpose electron tubes—tubes that will serve and meet the stiff and varied operational requirements of aviation, ordnance, marine and other fields of modern industry. Typical of these are receiving type tubes such as Beam-Power Amplifiers, R-F Pentodes, Twin Triodes, and the Full-Wave Rectifiers illustrated above and described below. All of these tubes are exhausted on a special automatic exhausting machine capable of extra high evacuation, and are aged under full operating and vibration conditions for a period of 50 hours. In addition to the tubes described above, Eclipse-Pioneer also manufactures special purpose tubes in the following categories: gas-filled control tubes, Klystron tubes, spark gaps, temperature tubes and voltage regulator tubes.

LOOK FOR THE PIONEER MARK OF QUALITY
REG. U. S. PAT. OFF.

**Electrical Characteristics of E-P Full-Wave Rectifier Tubes**

| TUBE TYPE | R.M.A. 5838 | R.M.A. 5839 | R.M.A. 5852 | R.M.A. 5993 |
|---|---|---|---|---|
| Heater Voltage . . . . . . . | 12 volts | 26.5 volts | 6.3 volts | 6.3 volts |
| Heater Current . . . . . . . | 0.6 amps. | 0.285 amps. | 1.2 amps. | 0.80 amps. |
| Peak Inverse Voltage . . . . | 1375 v. (max.) | 1375 v. (max.) | 1375 v. (max.) | 1250 v. (max.) |
| Peak Plate Current (per plate) | 270 ma. (max.) | 270 ma. (max.) | 270 ma. (max.) | 230 ma. (max.) |
| D-C Heater-Cathode Potential | 450 v. (max.) | 450 v. (max.) | 450 v. (max.) | 400 v. (max.) |
| Cathode Heating Time . . . . | 1 min. | 1 min. | 1 min. | 45 sec. |
| Total Effective Plate Supply Impedance . . . . . . . | 150 ohms (min.) | 150 ohms (min.) | 150 ohms (min.) | 150 ohms (min.) |

**Other E-P precision components for servo mechanism and computing equipment:**

Synchros • Servo motors and systems • rate generators • gyros • stabilization equipment • turbine power supplies and remote indicating-transmitting systems.

*For detailed information, write to Dept. A*

**ECLIPSE-PIONEER DIVISION of**
**TETERBORO, NEW JERSEY**

Bendix
AVIATION CORPORATION

Export Sales: Bendix International Division, 72 Fifth Avenue, New York 11, N. Y.

# SELENIUM RECTIFIERS

## HI-VOLTAGE SELENIUM RECTIFIER CARTRIDGES

### TYPICAL APPLICATIONS (PARTIAL LIST)

Bias Supplies
Cable Testing
Computing Machines
Condenser Testing
Condenser Storage Devices
Electron Multipliers
Electrostatic Precipitators
Electrostatic Spray Painting
Geiger-Muller Counters
Guided Missile Circuits
Inverse Peak Suppressors
Oscilliscopes
Photo-Flash Power Supplies
Radar Circuits
Television Circuits

In Triple X Phenolic Tube with nickel-plated brass ferrule at each end for insertion in standard 30-ampere Fuse Clips. 9/16" diameter. Length from 1 3/32" to 9", depending on DC output voltage rating. Half-wave.

**TYPE V-HF SERIES**
5 milliamperes DC

**PARTIAL LIST OF V-HF SERIES AVAILABLE**

| DC Output Volts | Rectifier Part No. | DC Output Volts | Rectifier Part No. | DC Output Volts | Rectifier Part No. |
|---|---|---|---|---|---|
| 20 | V1HF | 100 | V5HF | 800 | V40HF |
| 40 | V2HF | 200 | V10HF | 1000 | V50HF |
| 60 | V3HF | 400 | V20HF | 3000 | V150HF |
| 80 | V4HF | 600 | V30HF | 4000 | V200HF |

Half-Wave. In 9/16" phenolic tube with pigtail leads. Overall length varies from 25/32" to 9", depending on DC output voltage rating.

**TYPE Y-HP SERIES**
11 milliamperes DC

**PARTIAL LIST OF Y-HP SERIES AVAILABLE**

| DC Output Volts | Rectifier Part No. | DC Output Volts | Rectifier Part No. | DC Output Volts | Rectifier Part No. |
|---|---|---|---|---|---|
| 20 | Y1HP | 200 | Y10HP | 1000 | Y50HP |
| 60 | Y3HP | 400 | Y20HP | 2000 | Y100HP |
| 80 | Y4HP | 600 | Y30HP | 3000 | Y150HP |
| 100 | Y5HP | 800 | Y40HP | 4000 | Y200HP |

**PHOTOELECTRIC CELLS**

Self-generating type. Long life. Stable characteristics. Output up to 600 microamperes at 100 foot-candles illumination and 100 ohms external resistance.

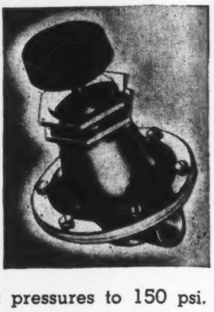
Unmounted Cells Available.

*Write for further details and literature*

**INTERNATIONAL RECTIFIER CORPORATION**
6809 S. Victoria Ave. THornwall 4145 Los Angeles 43

# PRECISION REGULATION

**Within .005 psi**



**FOR MANUAL LOADING SERVICE**... for remote positioning . . . for accurate flow meter calibration, our MODEL H-10 is tops in the field.

It's built especially for dead end (no flow) service . . . and guaranteed to be free from "drift" errors. Ranges 0-5; 0-25; 0-50; 0-125 psi for inlet pressures to 150 psi.

If you are looking for a pneumatic regulator that is sensitive to 005 psi (in 0-5 psi range), stable and foolproof, **HERE'S YOUR REGULATOR.**

**WRITE TODAY FOR BULLETIN PH-10**

**CONOFLOW CORPORATION**
2100 Arch St., Phila. 3, Pa.

Cono Controls

**REFRACTOMETERS**
American Optical
Applied Physics Corp.
Bausch & Lomb Optical
Central Scientific Co.
Dearborn Scientific
Ever Ready Thermometer
Fish-Schurman Corp.
Gaertner Scientific
Jarrell-Ash Co.
Optical Service & Dev.
Photovolt Corp.
Polarizing Instrument
Precision Scientific
Process & Instruments
Zeiss, Inc., Carl

**REFRACTORY TUBES**

Burrell Technical Supply
Minneapolis-Honeywell
Coors Porcelain Co.
Minneapolis-Honeywell
Wheatstone Corp.

**REGULATORS, AUTOMATIC (See Controls, Automatic; and object of measurement and control)**

**REGULATORS, AUTOMATIC, Air**
Acme Regulator Co.
AiResearch Div.
American Meter Co.
Arca Regulators, Inc.
Askania Regulator Co.
Assoc. Valve & Engrg.
Atlas Valve Co.
Automatic Control Co.
Automatic Temp. Control
Bailey Meter Co.
Bastian-Blessing Co.
Black, Sivals, Bryson
Block Mfg. Co.
Boekel & Co.
Boylston Co.
Bristol Co.
Brooke Eng. Co
Cash Co.
Clark Cooper Co.
Conoflow Corp.
Cutler-Hammer, Inc.
Davis Reg. Co.
Detroit Lubricator
Fischer & Porter
Fisher Governor Co.
Foster Engg. Co.
(Continued)
Foxboro Co.
Friez Instrument Div.
Fulton Sylphon Div.
General Controls
General Elec. Co.
Grove Regulator
Hagan Corp.
Hammel-Dahl Co.
Hays Corp.
H-B Instrument
Hoke, Inc.
Ideal Lab. Tool
Instrument Rep. & Mfg.
Johnson Service Co.
Kieley & Mueller
Klipfel Mfg.
Lammert & Mann Co.
Leslie Co.
**Linde Air Products Co.**
Manning, Maxwell & Moore
Mason Neilan Regulator
McAlear Mfg.
Mercoid Corp.
Mercon Regulator Co.
Minneapolis-Honeywell
Moore Products
Northern Equip. Co.
Partlow Corp.
(Continued)
Powers Regulator Co.
Preferred Utilities Mfg.
Republic Flow Meters
Reynolds Gas Regulator
Sampsel Time Control
Schade Valve Mfg.
Schutte & Koerting
Seely Inst. Co.
Shallcross Controls
Sprague Meter Co.
Spence Engineering Co.
Tagliabue Div.
Taylor Inst. Cos.
Trerice Co.
White-Rodgers Electric

**REGULATORS, AUTOMATIC, Atmospheric**
AiResearch Div.
American Meter Co.
Black, Sivals, Bryson
Cash Co.
Foster Engineering
Foxboro Co.
General Controls
Hagan Corp.
Hammel-Dahl Co.
Mason-Neilan Regulator
Powers Regulator Co.
Vapor Recovery Systems

**REGULATORS, AUTOMATIC, Boiler**
Ace Instrument
Askania Regulator Co.
Atlas Valve Co.
Bailey Meter Co.
Black, Sivals, Bryson
Brooke Eng. Co.
Campbell Co., J. A.
Cash Co.
Defender Inst. & Reg.
Douglass Automatic
Fisher Governor Co.
Foster Engg. Co.
Foxboro Co.
Fuel Watchman
General Controls
General Power Plant
General Regulator Corp.
Hagan Corp.
Hammel-Dahl Co.
Hays Corp.
Henszey Co.
Leeds & Northrup
Magnetrol
Mason-Neilan Regulator
McAlear Mfg. Co.
Mercon Regulator
Minneapolis-Honeywell
Perfex Corp.
Republic Flow Meters
Ruggles-Klingemann
Shallcross Controls
Tagliabue Div.
White Rodgers Elec.

**REGULATORS, AUTOMATIC, Compressed Gas**
American Meter Co.
Askania Regulator Co.
Bailey Meter Co.
Bastian-Blessing
Block Mfg. Co.
Bristol Co.
Brooke Eng. Co.
Cash Co.
Conoflow Corp.
Electrimatic Corp.
Fischer & Porter
Fisher Governor Co.
Foster Engineering
Foxboro Co.
Frick Co.
General Controls
Grove Regulator
Hammel-Dahl Co.
Hays Corp.
Hoke, Inc.
Manning, Maxwell & Moore
Mason-Neilan Regulator
McAlear Mfg. Co.
Mercon Regulator Co.
Moore Products
Natural Gas Equipment
Republic Flow Meters
Reynolds Gas Regulator
(Continued)
Robertshaw Thermostat
Schade Valve Mfg. Co.
Shallcross Controls
Tagliabue Div.
Vapor Recovery Systems

**REGULATORS, AUTOMATIC, Condensation (See Controllers, Automatic, Condensation)**

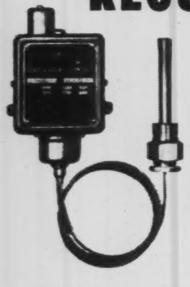
**REGULATORS, AUTOMATIC, Consistency (Paper & Pulp) (See Controllers, Automatic, Consistency)**

**REGULATORS, AUTOMATIC, Current**
Abrams Instrument
Amperite Corp.
Amplifier Co.
Askania Regulator Co.
Automatic Elec. Chicago
Automatic Temp. Control
Beck Bros.
Betts & Betts
Bradley Laboratories
Burlington Inst. Corp.
Clarostat Mfg. Co.
Cook Electric
Cutler-Hammer, Inc.
DoAll Co.
Doelcam Corp.
Eclipse-Pioneer Div.
Electric Regulator
Furst Electronics
General Controls
General Elec. Co.
Hagan Corp.
Lewis & Co., J. B.
Lindberg Engineering
Nankervis Co., G. L.
Raytheon Mfg. Co.
Rockwell Engr.
Roller-Smith
Rubicon Co.
Sherron Metallic
Sola Electric Co.
Sorensen & Co.
Thermo Electric Mfg.
Thordarson Elec. Mfg.
Westinghouse Elec.
Wheelco Instruments
Wilson & Co., G. C.

**REGULATORS, AUTOMATIC, Damper (See Controllers, Automatic, Damper)**

**REGULATORS, AUTOMATIC, District (See Governors, District)**

**REGULATORS, AUTOMATIC, Draft (See Controllers, Automatic, Draft)**



# REGULATORS...*NON-INDICATING TYPE FOR TEMPERATURE, PRESSURE, HUMIDITY, ETC.*

• Honeywell's complete line of electric, electronic and pneumatic industrial controls includes over a hundred different types of relays, controllers, step controllers, switches, solenoid and air-operated control valves, contactors, motors, thermostats, vacuumstats, vaporstats, etc. All are described in detail in Catalog 8304...sent at your request.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4579 Wayne Ave., Philadelphia 44, Pa.

MINNEAPOLIS
**Honeywell**
*Brown Instruments*

**REGULATORS, AUTOMATIC, Drying Chamber**
Automatic Temp. Control
Bailey Meter Co.
Barber-Colman
Bristol Co.
Foxboro Co.
Fulton-Sylphon Div.
General Controls
Hagan Corp.
Powers Regulator Co.
Trerice Co.
United Elec. Controls

**REGULATORS, AUTOMATIC, Feed Water (see Controllers, Automatic, Feed Water)**

**REGULATORS, AUTOMATIC, Flow (See Controllers, Automatic, Flow)**

**REGULATORS, AUTOMATIC, Flow Proportioning (See Controllers, Automatic, Flow Proportioning)**

**REGULATORS, AUTOMATIC, Fluid Proportioning (See Controllers, Automatic, Fluid Proportioning)**

**REGULATORS, AUTOMATIC, Frequency**
Allis-Chalmers
Burlington Inst. Corp.
Collins Radio Co.
Doelcam Corp.
Eclipse-Pioneer
Electric Regulator Corp.
General Controls
General Elec. Co.
Kellogg Switchboard
Leeds & Northrup
Magnetic Amplifiers
Metrotype Corp.
Robinette Co.
Telechron, Inc.
Westinghouse Elec.
Wheelco Inst. Co.

**REGULATORS, AUTOMATIC, Furnace (See Controllers, Automatic, Furnace)**

**REGULATORS, AUTOMATIC, Gas (See Regulators, Automatic, Air)**

**REGULATORS, AUTOMATIC, Humidity (See Controllers, Automatic, Humidity)**

**REGULATORS, AUTOMATIC, Liquid Level (See Controllers, Automatic, Liquid Level)**

**REGULATORS, AUTOMATIC, Load**
Allis-Chalmers Mfg. Co.
Burlington Inst. Co.
Fisher-Pierce Co.
Foxboro Co.
General Controls
Hagan Corp.
Hays Corp.
Lear, Inc.
Leeds & Northrup
Leslie Co.
Mosher Electronic
Norcross Corp.
Robinette Co., W. C.
Sorenson & Co.
Taylor Inst. Cos.
Westinghouse Elec.
Wilson & Co., G. C.

**REGULATORS, AUTOMATIC, Oil Feed**
Ace Instrument Co.
Askania Regulator Co.
Atlas Valve Co.
Bailey Meter Co.
Brooke Engineering
Brooks Rotameter
Cash Co.
Fischer & Porter
Fisher Governor
Foster Engg. Co.
General Regulator Corp.
Hagan Corp.
Hammel-Dahl Co.
Hays Corp.
Lammert & Mann Co.
Leslie Co.
Lumenite Electronic
Mason-Neilan Regulator
McAlear Mfg. Co.
National Airoil Burner
Republic Flow Meters
Sampsel Time Control
Spence Engineering Co.
Tagliabue Div.
Taylor Inst. Cos.
Vaughn-G. E. Witt Co.

**REGULATORS, AUTOMATIC, Phase**
Allis-Chalmers
Clarke Inst. Corp.
General Controls
General Electric
Kollsman Instrument
Robinette Co.
Westinghouse Elec.

**REGULATORS, AUTOMATIC, Power Factor**
Allis-Chalmers Mfg. Co.
General Controls
Leeds & Northrup Co.
Robinette Co.
Shallcross Controls
Sorensen & Co.
Westinghouse Elec.

**REGULATORS, AUTOMATIC, Pressure (See Controllers, Automatic, Pressure)**

**REGULATORS, AUTOMATIC, Pump**
Allen-Bradley Co.
Arca Regulators, Inc.
Askania Regulator Co.
Assoc. Valve & Engrg.
Atlas Valve Co.
Automatic Control
Automatic Temp. Control
Bailey Meter Co.
Beck Co.
Boylston Co.
Bristol Co.
Builders-Providence
B. W. Controller Corp.
Cash Co.
Climax Div.
Davis Reg. Co.
Fisher Governor Co.
Ford Reg. Valve Co.
Foster Engg. Co.
Fulton Sylphon Div.
Furnas Electric Co.
General Regulator Co.
Hagan Corp.
Hammel-Dahl Co.
Henszey Co.
Kieley & Mueller
Klipfel Mfg. Co.
Leslie Co.
Lumenite Electronic
Mason-Neilan Regulator
McAlear Mfg.
Mercon Regulator Co.
Northern Equip. Co.
Photoswitch, Inc.
Republic Flow Meters
Robinette Co., W. C.
Sampsel Time Control
Schade Valve Mfg. Co.
Spence Engineering Co.
Squires Co.
Swartwout Co.
Tagliabue Div.
Water Level Controls Co.
Yellow Spring Instrument

**REGULATORS, AUTOMATIC. Refrigeration (See Controllers, Automatic, Refrigeration)**

**REGULATORS, AUTOMATIC, RKVA**
Allis-Chalmers Mfg. Co.
General Electric
Leeds & Northrup
Thordarson Elec. Mfg.
Westinghouse Elec.

**REGULATORS, AUTOMATIC, Safety Fuel Shut-Off (See Valves, Automatic, Safety Fuel)**

**REGULATORS, AUTOMATIC, Steam Pressure (See Controllers, Automatic Pressure)**

**REGULATORS, AUTOMATIC, Synchronizing**
AiResearch Div.
Allis-Chalmers Mfg. Co.
Automatic Elec. Mfg. Co.
Burlington Inst. Co.
Control Corp.
Counter & Control Corp.
Cutler-Hammer, Inc.
Eclipse Pioneer
General Controls
General Electric
Lear, Inc.
Robinette Co.
Shallcross Controls
Westinghouse Elec.

**REGULATORS, AUTOMATIC, Temperature (See Controllers, Automatic, Temperature)**

**REGULATORS, AUTO MATIC, Time (See Controllers, Automatic, Time)**

**REGULATORS. Automatic, Tarque**
Askania Regulator
Vectron, Inc.

**REGULATORS, AUTOMATIC, Vacuum (See Controllers, Automatic, Pressure & Vacuum)**

**REGULATORS, AUTOMATIC, Viscosity (See Controllers, Automatic, Viscosity)**

**REGULATORS, AUTOMATIC, Voltage**
Allis-Chalmers
American Transformer
Amperite Corp.
Amplifier Co.
Askania Regulator Co.
Automatic Elec. Chicago
Beck Co.
Boonton Radio Corp.
Bradley Laboratories
Burlington Inst. Corp.
Clarostat Mfg. Co.
Clippard Inst. Lab.
Collins Radio Co.
Commercial Research
Communication Meas. Lab.
Control Corp.
Doelcam Corp.
Eclipse-Pioneer
Electronic Associates
El-Tronics, Inc.
Federal Telephone
Ferris Inst. Corp.
Fredericks, George
Furst Electronic
General Elec. Co.
Hastings Instrument
International Resistance
Kellogg Switchboard
Laboratory for Electronics

(Continued)

La Marche
Lewis & Co., J. B.
Magnetic Amplifiers
Miller Co., Bertrand F.
Nuclear Inst. & Chem.
Oregon Electronic
Polarad Electronics
Process & Instruments
Raytheon Mfg. Co.
Reliance Instrument
Richardson-Allen
Rockwell Engr.
Sherron Metallic
Sola Electric Co.
Sorensen & Co.
Superior Electric
Sylvania Elec. Prods.
Thordarson Elec. Mfg.
United Transformer Corp.
Walkirt Co.
Ward Leonard Elec. Co.
Westinghouse Elec.
Wheelco Instruments
Wilson & Co., G. C.
Yellow Spring Inst. Co.

**REGULATORS, AUTOMATIC, Water Pressure (See Controllers, Automatic, Pressure)**

**REGULATORS, AUTOMATIC, Welding, Gas**
Bastian-Blessing Co.
Cutler Hammer, Inc.
Grove Regulator
Hoke, Inc.
Linde Air Products

**RELAYS, Automatic**
Adams & Westlake
Advance Elec. & Relay
Allen-Bradley Co.
American Inst. Co.
American Relay & Controls
Amperite Co.
Autocall Co.
Automatic Elec. Chicago
Automatic Elec. Mfg.
Automatic Temp. Control
Beck Co.
Clare & Co.
Climax Div.
Cook Electric Co.
Cramer Co., Inc.
Cutler-Hammer, Inc.
Eastern Industries
Eclipse-Pioneer
Edison, Inc., Thomas
Esterline-Angus
General Controls Co.
General Elec. Co.
Guardian Elec. Mfg. Co.
Hagan Corp.
H-B Instrument
Industrial Eng. Corp.

(Continued)

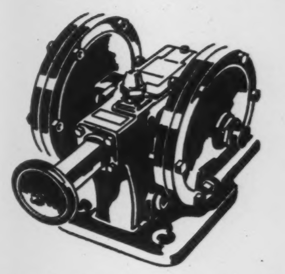
Industrial Timer Corp.
Kellogg Switchboard
Mercoid Corp.
Minneapolis-Honeywell
Neomatic Inc.
Perfex Corp.
Phillips Control
Potter & Brumfield
Roller-Smith
Struthers-Dunn
Triplett Elec. Inst.
Ward Leonard Elec. Co.
Westinghouse Elec.
Weston Elec. Inst. Corp.

**RELAYS, Capacity-Operated**
Automatic Elec. Chicago
Automatic Elec. Mfg.
Automatic Temp. Control
Browning Labs.
Cook Electric
Electronic Lab.
Electro-Physics
El-Tronics, Inc.
Fielden Instrument
General Controls
General Electric
Lumenite Electronics
Potter & Brumfield
Struthers-Dunn
Thermo Instruments

**RELAYS, Circuit Control**
Adams & Westlake
Advance Elec. & Relay Co.
Allen-Bradley Co.
Allied Control Co.
American Inst. Co.
American Relay & Controls
Amperite Co.
Autocall Co.
Automatic Elec., Chicago
Automatic Elec. Sales
Automatic Switch Co.
Automatic Temp. Control
Beck Co.
Clare & Co.
Cook Electric Co.
Cutler-Hammer, Inc.
De-Tec-Tronics Labs.
Dorothea Mechanisms
Eastern Industries
Eclipe Pioneer
Edison Electrical Control
Federal Telephone
Friez Inst. Div.
General Controls
General Elec. Co.
H-B Instrument
Hufco Industries
Industrial Timer Corp.
Kellogg Switchboard
Leach Relay Co.
Lumenite Elec.
Miller Co., Bertrand F.

(Continued)

*Precision*
REGULATORS

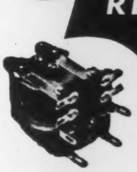


Askania Regulators assure exacting pressure, flow or proportioning control, through the operation of cylinders, valves, dampers or other mechanisms. Built around the exclusive Jet-Pipe Principle, Askania Regulators convert signals or impulses into extremely accurate proportionate movements of the mechanisms.

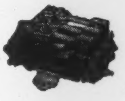
*Full information available.*

ASKANIA Controls

**ASKANIA REGULATOR COMPANY**
246 E. Ontario St., Chicago 11, Ill.
A Subsidiary of
General Precision Equipment Corporation



For Advanced RELAYS specify ADVANCE

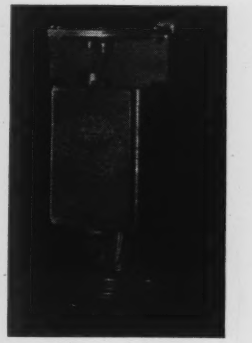


RELAYS for general circuit control, electronic, aircraft and marine applications. Crisp action, dependable and durable. ADVANCE offers sensitive, midget, midget telephone, keying, instrument, time-delay, overload, transmission line, impulse, hermetically sealed, and ceramic insulated relays. Wide variations of these types for special applications and special relays made to specifications.

ADVANCE'S engineering ability and manufacturing facilities will assist in engineering problems and supply special relays for the most exacting requirements. Your inquiry will receive prompt and courteous attention.

ADVANCE RELAYS

**ADVANCE ELECTRIC & RELAY CO.**
**2435 North Naomi St., Burbank, Calif.**



**REPUBLIC REGULATORS**

Republic pneumatic or hydraulic type regulators are supplied for the automatic control of pressure, rate of flow, speed of rotation, liquid level, or the proportioning of two pressures, flows, etc., in a fixed ratio.

They measure the quantities they control regardless of the application. They can be made sensitive to changes of less than 0.002 in. of water.

WRITE FOR DATA BOOK No. S-13

**REPUBLIC FLOW METERS CO.**
**2240 Diversey Pkwy. Chicago 47, Ill.**

**REPUBLIC INSTRUMENTS • CONTROLS**

Minneapolis-Honeywell
Neomatic Inc.
Perfex Corp.
Phillins Controls
Photoswitch
Precision Scientific
Potter & Brumfield
Roller-Smith
Sampsel Time Control
Shepard Labs.
Sigma Instrument, Inc.
Struthers-Dunn
Triplett Elec. Inst.
Ward Leonard Elec. Co.
Westinghouse Elec.
Weston Elec. Inst. Corp.

### RELAYS, Continuous Current

Adams & Westlake
Advance Elec. & Relay Co.
Allen-Bradley Co.
Allied Control Co.
American Inst. Co.
Arrow-Hart & Hegeman
Autocall Co.
Automatic Elec. Chicago
Automatic Elec. Sales
Automatic Switch
Automatic Temp. Control
Clare & Co.
Cook Electric Co.
Cutler-Hammer, Inc.
Eclipse-Pioneer
Esterline-Angus
General Controls
General Elec. Co.
Guardian Elec. Mfg. Co.
H-B Instrument
Industrial Timer Corp.
Kellogg Switchboard
Leach Relay Co.
Neomatic Inc.
Potter & Brumfield
Price Electric Corp.
Sigma Instruments
Struthers-Dunn
Triplett Elec. Inst.
Ward Leonard Elec. Co.
Westinghouse Elec.
Weston Elec. Inst. Corp.

### RELAYS, Control

Adams & Westlake
Advance Elec. & Relay Co.
Allen-Bradley Co.
American Inst. Co.
American Relay & Controls
Amperite Co.
Autocall Co.
Automatic Elec. Chicago
Automatic Elec. Sales
Automatic Temp. Control
Bailey Meter Co.
Barber-Colman
Beck Co.
Betts & Betts
Brown Inst. Div.
B. W. Controller Corp.
Clare & Co.
Control Corp.
Cook Electric Co.
Cutler-Hammer, Inc.
**Dorothea Mechanisms**
Eastern Industries
Eclipse-Pioneer
Edison, Inc, Thomas
Fisher-Pierce Co.
General Controls Co.
General Elec. Co.
Guardian Elec. Mfg. Co.
G-V Controls
Hagan Corp.
H-B Instrument
Industrial Eng. Corp.
Industrial Timer Corp.
Kellogg Switchboard
Leach Relay Co.
Miller Co., Bertrand F.
Minneapolis-Honeywell
National Time & Signal
Neomatic Inc.
Perfex Corp.
Phillips Control
Photoswitch, Inc.
Potter & Brumfield
Precision Scientific
Precision Therm.
Price Electric Corp.
Robinette Co., W. C.
Roller-Smith Co.
Sampsel Time Control
Sigma Instruments
Struthers-Dunn
Triplett Elec. Inst.
Ward Leonard Elec. Co.
Westinghouse Elec.
Weston Elec. Inst. Corr
White Rodgers Elec

### RELAYS, Current

Adams & Westlake
American Instrument
Betts & Betts
General Electric Co.
Guardian Electric
H-B Instrument
Neomatic Inc.
Perfex Corp.
Phillips Control
Potter & Brumfield
Roller-Smith
Sigma Instruments
Triplett Elec. Inst.
Ward Leonard
Westinghouse Elec.
Weston Elec. Inst. Corp.

### RELAYS Demand Totalizing

Autocall Co.
Automatic Elec. Chicago
General Elec. Co.
Guardian Electric
Hagan Corp.
Westinghouse Elec.

### RELAYS, Electromagnetic

Advance Elec. & Relay Co.
Allen-Bradley Co.
Allied Control Co.
American Inst. Co.
American Relay & Controls
Amperite Co.
Arrow-Hart & Hegeman
Autocall Co.
Automatic Elec. Chicago
Automatic Elec. Mfg. Co.
Automatic Switch Co.
**Bunnell & Co.**
Control Corp.
Cook Electric Co.
Clare & Co.
Cutler-Hammer, Inc.
Doelcam Corp.
Eastern Industries
Eby, Inc.
Eclipse-Pioneer
Edison, Inc., Thomas A.
Engineering Res. & Dev.
Friez Instrument Div.
General Elec. Co.
G-M Labs.
Gorrell & Gorrell
Guardian Elec. Mfg. Co.
H-B Instrument
Hufco Industries
Industrial Eng. Corp.
Kellogg Switchboard
Leach Relay Co.
Miller Co., Bertrand F
Minneapolis-Honeywell
National Time & Signal
Neomatic Inc.
Penn Electric Switch Co.
Perfex Corp.
Phila. Thermometer Co
Phillips Control
Potter & Brumfield
Precision Scientific
Precision Therm. & Inst.
Price Electric Corp.
Sigma Instruments, Inc
Stromberg Time Corp.
Struthers-Dunn
Tork Clock
Triplett Elec. Inst.
Ward Leonard Elec. Co.
Warrick Co.
Westinghouse Elec.
Weston Elec. Inst. Corp.
White-Rodgers Electric

### RELAYS, Electronic

Advance Elec. & Relay Co.
American Inst. Co.
Automatic Elec. Mfg.
Automatic Temp. Control
Beck Co.
Bell & Howell
Berkshire Laboratories
Central Scientific
Clare & Co., C. P.
Coleman Electric
Cook Electric
Cramer Co., Inc.
Cutler-Hammer, Inc.
Davis & Co., Inc., Dean
De-Tec-Tronics Labs.
Eclipse-Pioneer
Electro-Medical Lab
Electronic Dev. Lab.
Electro-Physics Co.
Engrg. Research & Dev.
Ess instrument
Fisher-Pierce Co.
Fisher Scientific Co.
General Elec. Co.
Gorrell & Gorrell
Guardian Elec. Mfg.
Harvey Radio Labs.
H-B Instrument
Leach Relay Co
Lumenite Co.
Lyman Electronic
Minneapolis-Honeywell
Neomatic Inc.
Phillips Control
Phipps & Bird
Photoswitch, Inc.
Potter & Brumfield
Price Electric Corp.
Process & Instruments
RCA Div.
Robinette Co., W. C.
Rockwell Engr.
Sigma Instruments
Struthers-Dunn
Televiso Products
Thordarson Elec. Mfg.
Wilson & Co., G. C.

### RELAYS, Frequency

Autocall Co.
Automatic Elec. Chicago
Automatic Switch Co.
Biddle Co.
Clare & Co., C. P.
Control Corp.
Cook Electric
Cutler-Hammer, Inc.
Eclipse-Pioneer
Esterline-Angus Co.
General Elec. Co.
Guardian Electric
Hickok Electrical Inst.
Kellogg Switchboard
Potter & Brumfield
Sigma Instruments
Stevens-Arnold Co.
Wallace & Tiernan
Ward Leonard Electric Co.
Westinghouse Elec.

### RELAYS, Galvanometer

Assembly Products
Autocall Co.
Automatic Elec. Chicago
Automatic Temp. Control
Cole Instrument
Eby, Inc., Hugh H.
Esterline-Angus
Potter & Brumfield
Roller-Smith
Rubicon Co.
Tagliabue Div.

### RELAYS, Heavy Duty

Adams & Westlake
Advance Elec. & Relay Co.
Allen-Bradley Co.
American Inst. Co.
American Relay & Controls
Autocall Co.
Automatic Elec. Chicago
**Automatic Elec. Mfg.**
Automatic Switch Co.
Automatic Temp. Control
Cook Electric
Cutler-Hammer, Inc.
Eclipse-Pioneer
Esterline-Angus
General Elec. Co.
H-B Instrument
Leach Relay Co.
Miller Co., Bertrand F.
Philadelphia Thermometer
Potter & Brumfield
Price Electric Corp.
Struthers-Dunn
Ward Leonard Elec. Co.
Westinghouse Elec.
Weston Elec. Inst. Corp.
Zenith Electric Co.

### RELAYS, Instrument Controlled

Adams & Westlake
Advance Elec. & Relay
American Inst. Co.
Assembly Products
Autocall Co.
Automatic Elec. Chicago
**Automatic Elec. Mfg.**
Automatic Temp. Control
Bailey Meter Co.
Barber-Colman
Beck Co.
Carter Radio Div.
Clare & Co.
Climax Div.
Cole Instrument
Cook Electric Co.
Cramer & Co., Inc.
Eclipse-Pioneer
Electric Des. & Mfg.
Friez Instrument Div.
General Elec. Co.
Guardian Elec. Mfg. Co.
H-B Instrument
Minneapolis-Honeywell
Neomatic Inc.
Perfex Corp.
Phila. Thermometer Co.
Potter & Brumfield
Precision Scientific
Precision Therm.
Roller-Smith Co.
Sigma Instruments
Struthers-Dunn
Tagliabue Div.
Tork Clock
Triplett Electrical Inst.
Ward Leonard Elec. Co.
Weston Elec. Inst. Corp.

### RELAYS. Light Sensitive (See Photoelectric below)

### RELAYS, Magnetic (See Relays, Electromagnetic)

### RELAYS, Mercury

Adams & Westlake
American Inst. Co.
Autocall Co.
Automatic Elec. Chicago
Automatic Temp. Control
Continental Elec. Co.
Durakool Inc.
Ebert Electronics
Electronic Apparatus
Guardian Electric
H-B Instrument
Potter & Brumfield
Precision Scientific
Precision Therm.
Struthers-Dunn
Weston Elec. Inst. Corp.

### RELAYS, Mercury Tube

Adams & Westlake
American Inst. Co.
Autocall Co.
Automatic Elec. Chicago
Automatic Temp. Control
Clare & Co.
General Controls Co.
G-M Labs.
Guardian Elec. Mfg. Co.
H-B Instrument
Kellogg Switchboard
Mercoid Corp.
Minneapolis-Honeywell
Phila. Thermometer
Potter & Brumfield
Precision Scientific
Precision Therm.
Struthers-Dunn
Ward Leonard Elec. Co.
Weston Elec. Inst. Corp.

### RELAYS. Motor Driven Time Delay

Advance Elec. & Relay Co.
Allen-Bradley Co.
American Inst. Co
Automatic Elec. Mfg.
Barber-Colman
Betts & Betts
Clarostat Mfg. Co.
Controls, Inc.
Cramer Co., Inc.
Eagle Signal Co.
**Friez Instrument**
General Controls
General Electric
Guardian Electric
Haydon Co., A. W.
Industrial Eng. Corp.
Industrial Timer
Lumenite Electronics

(Continued)

Paragon Electric Co.
Potter & Brumfield
Price Electric Co.
Struthers-Dunn
Ward Leonard Elec. Co.
Westinghouse Elec.
Weston Elec. Inst. Corp.
Zenith Electric Co.

### RELAYS, Movable Coil A.C.

Advance Elec. & Relay
Automatic Elec. Mfg.
Electro-Tech. Equip.
Esterline-Angus Co.
General Elec. Co.
Roller-Smith Co.
Triplett Elec. Inst.
Westinghouse Elec.
Weston Elec. Inst. Corp.

### RELAYS, Overload

Adams & Westlake
Advance Elec. & Relay Co.
Allen-Bradley Co.
American Relay & Controls
Autocall Co.
Automatic Elec. Chicago
**Automatic Elec. Mfg.**
Automatic Switch Co.
Automatic Temp. Control
Bunnell & Co.
Burlington Inst. Corp.
Clare & Co.
Cook Electric
Cutler-Hammer, Inc.
Edison, Instrument Div.
General Elec. Co.
Guardian Elec. Mfg. Co.
Leach Relay Co.
Potter & Brumfield
Price Electric Corp.
Roller-Smith Co.
Sigma Instruments
Standard Elect. Prods.
Struthers-Dunn
Ward-Leonard Elec. Co.
Westinghouse Elec.

### RELAYS, Permanent Magnet Movable Coil

Assembly Products
Bunnell & Co.
Cole Instrument
Electric Des. & Mfg.
Esterline-Angus Co.
General Elec. Co.
Guardian Electric
Roller-Smith Co.
Triplett Electrical Inst.
Westinghouse Elec.
Weston Elec. Inst. Corp.

### RELAYS, Photoelectric

Advance Elec. & Relay Co.
American Inst. Co.
Automatic Temp. Control
Autotron Co.
Clare & Co.
Continental Elec. Co.
Cutler-Hammer, Inc.
Detect-O-Ray
De-Tec-Tronic Labs.
Dickson Co.
Eby, Inc.
Electro-Physics Co.
Electronic Controls
Electronic Dev. Lab.
El-Tronics, Inc.
Engrg. Research & Dev.
Ess Instrument Co.
Fisher-Pierce Co.
General Controls Co.
General Elec. Co.
Gorrell & Gorrell
Guardian Electric
Leach Relay Co.
Lumenite Elec.
Phillips Control
Phipps & Bird
Potter & Brumfield
Potter Instrument
Photoswitch, Inc.
Precision Therm.
Rockwell Engr.
Rubicon Co.
Sigma Instruments, Inc.
Tagliabue Div.
Triplett Elec. Co.
Ward Leonard Elec. Co.
Westinghouse Elec. & Mfg.
Weston Elec. Inst. Corp.

### RELAYS, Polarized

Autocall Co.
Automatic Elec. Chicago
**Automatic Elec. Mfg.**
Barber Colman
Bunnell Co., J. H.
Eclipse-Pioneer
General Electric
L. A. B. Corp.
Maxson Corp.
Miller Co., Bertrand F.
Neomatic Inc.
Precision Therm. & Inst.
Price Electric Corp.
Sigma Instruments
Stevens-Arnold Co.
Struthers-Dunn
Triplett Elec. Inst.
Westinghouse Elec.
Weston Elec. Inst. Corp.

### RELAY, Power

Advance Elec. & Relay Co.
Allen-Bradley Co.
American Inst. Co.
American Relay & Controls
Automatic Elec. Chicago
**Automatic Elec. Mfg.**
Automatic Switch Co.
Clare & Co.
Cutler-Hammer, Inc.
Detect-O-Ray
Eclipse-Pioneer
Esterline-Angus Co.
General Controls Co.
General Elec. Co.

(Continued)

Grayhill
Hagan Corp.
H-B Instrument
Leach Relay Co.
Phillips Control
Potter & Brumfield
Price Electric Corp.
Robinette Co., W. C.
Roller-Smith Co.
Struthers-Dunn
Ward Leonard Elec. Co.
Westinghouse Elec.
Weston Elec. Inst. Corp.

### RELAYS. Power Factor

Advance Elec. & Relay Co.
Cutler-Hammer, Inc.
Esterline-Angus Co.
General Electric Co.
L. A. B. Corp.
Potter & Brumfield
Westinghouse Elec.

### RELAYS, Resistance, D.C.

Advance Elec. & Relay Co.
American Relay & Controls
Autocall Co.
Automatic Electric Chicago
Bunnell & Co.
Clare & Co., C. P.
Cook Electric Co.
Cutler-Hammer, Inc.
Electro-Physics Co.
Esterline Angus
General Elec. Co.
Guardian Electric
Kellogg Switchboard
Leach Relay Co.
Neomatic Inc.
Potter & Brumfield
Price Electric Corp.
Sigma Instruments
Ward Leonard Elec. Co.

### RELAY, Sounding

Leupold & Stevens

### RELAYS, Stepping

Autocall Co.
Automatic Elec. Chicago
Automatic Elec. Sales
Clare & Co.
Collins Radio Co.
Cook Electric
Dorothea Mechanisms, Gale
General Elec. Co.
G-M Laboratories, Inc.
Guardian Electric
Oak Mfg. Co.
Roller-Smith
Struthers-Dunn
Westinghouse Elec.

### RELAYS. Telephone Auxiliary Ringing

Advance Elec. & Relay Co.
American Relay & Controls
Autocall Co.
**Automatic Elec. Chicago**
Clare & Co.
Cook Electric
Federal Telephone
Guardian Electric
Kellogg Switchboard
Leach Relay Co.
Phillips Control
Potter & Brumfield
Price Electric Corp.
Sigma Instruments
Struthers-Dunn

### RELAYS, Temperature

Advance Elec. & Relay Co.
Assembly Products
Autocall Co.
Automatic Temp. Control
Clare & Co., C. P.
Cole Instrument
Cook Electric Co.
Edison Elec. Controls
Friez Instrument Div.
General Controls
General Elec. Co.
Gleason-Avery, Inc.
G-M Laboratories, Inc.
Guardian Electric
G-V Controls
H-B Instrument
Lewis Engineering
Leach Relay Co.
Minneapolis-Honeywell
Neomatic Inc.
Potter & Brumfield
Sampsel Time Control
Spencer Thermostat Co.
Struthers-Dunn
Tagliabue Div.
Triplett Elec. Inst.
Westinghouse Elec.
Weston Electrical Inst.

### RELAYS, Temperature Compensated

Betts & Betts
Edison, Inc., Thomas
Fuel Watchman
Guardian Electric
Neomatic Inc.
Sigma Instruments
Wallace & Tiernan

### RELAYS, Thermal Time Delay

Adams & Westlake
Advance Elec. & Relay Co
Allen-Bradley Co.
Am. Gas Accumulator
American Inst. Co.
American Relay & Controls
Amperite Corp.
Autocall Co.
Automatic Elec. Chicago
**Automatic Elec. Mfg.**
Automatic Temp. Control
Betts & Betts
Clare & Co.
Clarostat Mfg. Co.
Cook Electric Co.
Cramer Co., Inc.
Cutler-Hammer, Inc.
Eagle Signal Corp.

(Continued)

Edison, Inc., Thomas
Electronic Prod. Co.
Fisher-Pierce Co.
General Controls
General Elec. Co.
Guardian Elec. Mfg. Co.
G-V Controls
Industrial Eng. Corp.
Industrial Timer Corp.
Leach Relay Co.
Lumenite Electronics
Meletron Corp.
Partlow Corp.
Perfex Corp.
Photoswitch
Potter & Brumfield
Precision Therm.
Preferred Utilities Mfg.
Roller-Smith Co.
Sigma Instruments
Struthers-Dunn
Ulanet Co., Geo.
Ward Leonard Elec. Co.
Weston Elec. Inst. Corp.
Westinghouse Elec.
White-Rodgers Electric

### RELAYS, Time Delay (See Relays. Thermal Time Delay

### RELAYS, Transformer (Low Voltage)

Advance Elec. & Relay Co.
Allen-Bradley Co.
Auth Elec. Spec.
**Automatic Electric Chicago**
Barber-Colman
B. W. Controller Corp.
Friez Instrument Div.
General Controls Co.
General Elec. Co.
Gleason-Avery, Inc.
Guardian Elec. Mfg. Co.
H-B Electric
Industrial Eng. Corp.
Lumenite Electronics
Mercoid Corp.
Miller Co., Bertrand F.
Minneapolis-Honeywell
Partlow Corp.
Perfex Corp.
Potter & Brumfield
Sampsel Time Control
Sigma Instruments, Inc.
Struthers-Dunn
Thordarson Elec. Mfg.
Ward Leonard
Warrick Co.
Westinghouse Elec.
White-Rodgers Electric

### RELAYS, Vaccum Contact

American Inst. Co.
Edison, Inc., Thomas
Eitel McCullough
General Elec. Co.
H-B Instrument
Lumenite Electronics
Rockwell Engr.
Skaneateles Mfg. Co.
Struthers-Dunn, Inc.

### RELAYS, Vacuum Tube

Advance Elec. & Relay Co.
American Inst. Co.
Amperite Co.
**Automatic Elec. Mfg.**
Automatic Temp. Control
Berkshire Laboratories
Continental Elec. Co.
Eby, Inc.
Eclipse-Pioneer
Edison, Inc., Thomas
Electro-Medical Lab.
Electronic Dev. Lab.
Electronic Prod. Co.
El-Tronics, Inc.
Fisher-Pierce Co.
General Controls Co.
General Elec. Co.
Harvey Radio Labs.
H-B Instrument
Kellogg Switchboard
L. A. B. Corp.
Leach Relay Co.
Lumenite Electronics
Metron Instrument
Neomatic Inc.
Precision Therm.
Robinette Co., W. C.
Rockwell Engr. Co.
Sigma Instruments
Skaneateles Mfg. Co.
Struthers-Dunn
Sylvania Elec. Prods.
Tagliabue Div.
Wilson & Co.

### RELAYS, Voltage

Adams & Westlake
Advance Elec. & Relay
Allen-Bradley Co.
American Relay & Control
Amperite Co.
Autocall Co.
Automatic Elec. Chicago
**Automatic Elec. Mfg.**
Automatic Switch Co.
Barber-Colman
Clare & Co., C. P.
Cook Electric
Cutler-Hammer, Inc.
Eby, Inc., Hugh H.
Eclipse-Pioneer
Esterline-Angus Co.
Ferranti Electric, Inc.
General Controls
General Elec. Co.
Guardian Electric
G-V Controls
Hart Manufacturing Co.
Hathaway Inst. Co.
Leach Relay Co.
Lumenite Electronic
Neomatic Inc.
Philips Control
Potter & Brumfield
Reliance Instrument Co.

(Continued)

# GUARDIAN

## QUALITY Controls

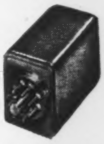
## RELAYS...

### HERMETICALLY SEALED

A. N. CONNECTOR

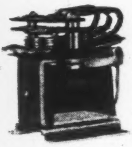
SCREW TERMINAL

LUG HEADER


OCTAL PLUG

### OPEN TYPE CONSTRUCTION

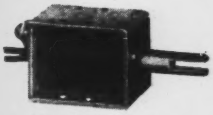
Series 120 A. C.

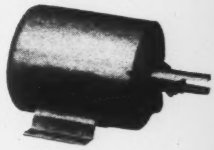

Series 345 D. C.

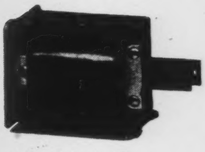
Series 595 D. C.

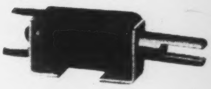
## ...SOLENOIDS

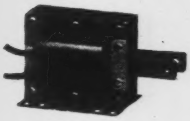
No. 1A A. C.


No. 4 A. C.


No. 7 D. C.

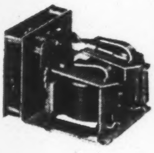

No. 14 A. C.

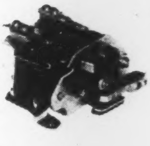

No 1A D. C.


No. 12 A. C.

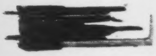
## STEPPERS

Series R


Series M. E. R.


Series M. A. S.

## SWITCHES



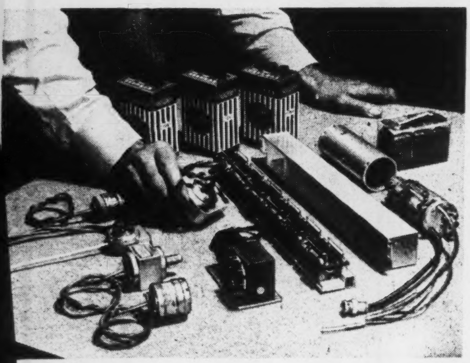
**GUARDIAN RELAYS**—standard equipment in virtually all U. S. warplanes, exemplify the highest degree of *electronic precision* required by the U. S. Air Force, by government agencies, aircraft manufacturers and instrument makers. Available *hermetically sealed* to government specifications in lightweight *aluminum* which permits heavier relay frames, larger contacts, higher capacities—more control in less space!

**GUARDIAN G ELECTRIC**

1628-MI W. WALNUT STREET CHICAGO 12, ILLINOIS

A COMPLETE LINE OF RELAYS SERVING AMERICAN INDUSTRY

Complete Telemetering Facilities from Bendix-Pacific



*This complete 6 channel AN/DKT-3 telemetering system with pickups weighs less than 12½ pounds.*

Bendix-Pacific telemetering facilities can provide you with any phase of a complete instrumentation service. These include:

AIRBORNE COMPONENTS

The standard AN/DKT 3 subminiature telemetering components which remotely measure and indicate acceleration, motion and position, pressure, strain, temperature, vibration, velocity, voltage and current. Transmitted power up to 15 watts is available.

RECEIVING STATIONS...

New instrumentation equipment designed to receive frequency-modulated signals employing continuous or commutated subcarriers. A maximum of 14 continuous subcarriers can be received simultaneously and up to 27 signal channels can be separated from one commutated subcarrier, each signal can be recorded as a continuous trace.

ENGINEERING...

Application engineering to adapt the Bendix-Pacific System to each specific problem.

INSTALLATION...

Supervision of initial installation.

FLIGHT TESTING...

Flight testing, reduction and analysis of data.

WRITE FOR COMPLETE INFORMATION

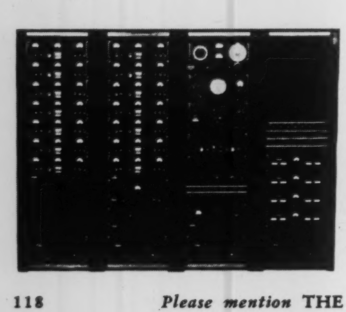


*Photo at left shows typical 14 band Bendix Receiving Station.*

Bendix

Pacific Division
Bendix Aviation Corporation
NORTH HOLLYWOOD, CALIF.

TO MEASURE..TO WARN..TO INDICATE..AT A DISTANCE

Roller-Smith Co.
Sigma Instruments
Simpson Electric
Struthers Dunn, Inc.
Sylvania Elec. Prod.
Triplett Electrical Inst.
Ward Leonard Elec. Co.
Westinghouse Elec.
Weston Electrical Inst.

### REMOTE CONTROL EQUIPMENT

General Electric
Magnetic Amplifiers
Minneapolis-Honeywell
Stewart Mfg. Corp.

### REMOTE - METERING EQUIPMENT, ELECTRICAL

Ace Instrument Co.
Aero Electronics
American Temp. Ind.
Applied Science Corp.
Automatic Temp. Control
Bristol Co.
Brooks Rotameter
Builders-Providence
Clarke Inst. Corp.
Cole Instrument
Control Corp.
Elec. Tachometer Corp.
Electro-Mechanical Research
Electronic Associates
Engrg. Research & Dev.
Esterline-Angus Co.
Farnsworth Television
Fielden Instrument
Fischer & Porter
Flader, Inc., Fredric
Foxboro Co.
General Elec. Co.
W. & L. E. Gurley
Hagan Corp.
Hathaway Inst. Co.
Hays Corp.
H & H Thermostats
Hillyer Inst.
Jacobs Instruments
Kellogg Switchboard
Kollsman Inst. Div.
L. A. B. Corp.
Landis & Gyr
Leeds & Northrup Co.
Lenkurt Electric Co.
Martin-Hubbard Corp.
Mason-Neilan Regulator
Metrotype Corp.
Minneapolis-Honeywell
Moisture Register Co.
Moore Products
Pacific Div.
Panoramic Radio Co.

(Continued)

Penn Ind. Inst. Co.
Pioneer Instrument
Polarad Electronics
Rahm Instruments
Republic Flow Meters
Revere Corp.
Rosen Engg. Products
Schaevitz Eng.
Servo Corp. of America
Sherron Metallic
Skaneateles Mfg. Co.
Statham Labs.
Tagliabue Div.
Van Dyke Instruments
Vapor Recovery Systems
Westinghouse Elec.
Wiancko Engineering
Wilson & Co.
Yardeny Engineering

### REMOTE - METERING EQUIPMENT, HYDRAULIC

Automatic Temp. Control
Builders-Providence
Emery Co., A. H.
Farris Engg. Corp.
Leupold & Stevens
Mason-Neilan Regulator
Pacific Div.
Servo Corp. of America
Skaneateles Mfg. Co.
Smith Meter Co.
Westinghouse Elec.

### REMOTE-METERING EQUIPMENT, Pneumatic

American Meter Co.
Automatic Temp. Control
Bristol Co.
Brooks Rotameter
Builders-Providence
Conoflow Corp.
Emery Co., A. H.
Farris Engg. Corp.
Fischer & Porter
Foxboro Co.
Hagan Corp.
Haydon Co., A. W.
Mason-Neilan Regulator
Minneapolis-Honeywell
Moore Products
Republic Flow Meters
Servo Corp. of America
Taylor Inst. Co.

### RESISTANCE LOADING EQUIPMENT

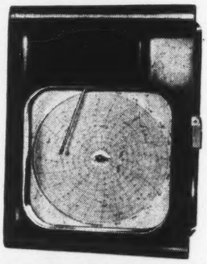
Cole Instrument
De Jur-Amsco
Eastern Specialty Co.
General Elec. Co.
Hardwick, Hindle, Inc.
International Resistance
Precision Resistor Co.
Shallcross Mfg.
Ward Leonard

BRISTOL'S

EXCLUSIVE

METAMETER*

Telemeter — Remote measurement and automatic control

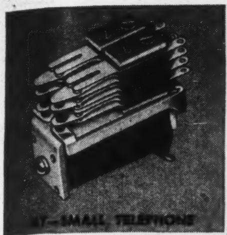


SERIES 500 RECEIVER

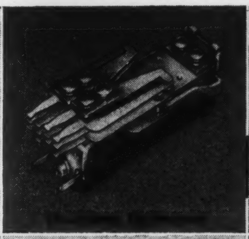
Bristol's Metameter System of Telemetering gives an accurate, up-to-the-minute account of conditions at remote points . . . enables you to anticipate abnormalities . . . prevent them from developing into emergencies. Measures pressure, flow, temperature, liquid level, motion and gate position, voltage, current power, totalized power load, and reactive volt amperes. The impulse-duration principle on which the Bristol Metameter operates gives you the further advantage of a choice of transmitting media: carrier channel . . . telephone, simple two-wire circuit . . . radio beam (microwave) . . . or any convenient circuit you may select.

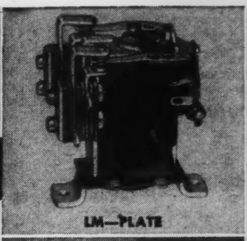
ALSO: REMOTE AUTOMATIC CONTROL.
*Reg. U.S. Pat. Off.

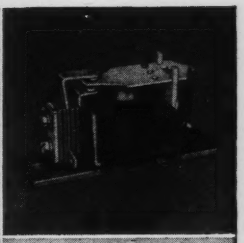
THE BRISTOL COMPANY
113 BRISTOL RD., WATERBURY 20, CONN.

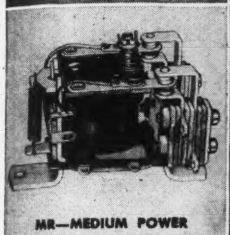

ST—SMALL TELEPHONE

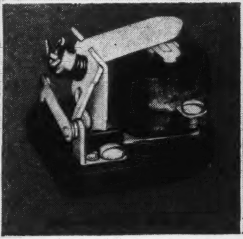
ST—SHORT TELEPHONE

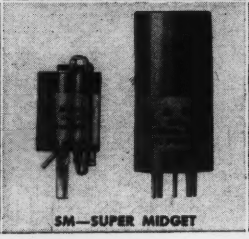


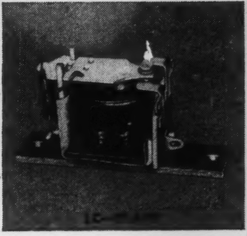

LM—PLATE

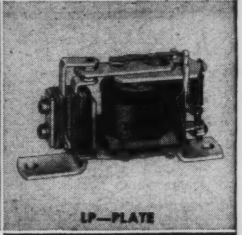


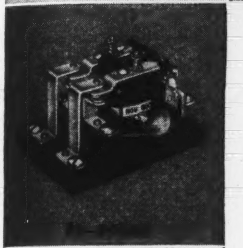

MR—MEDIUM POWER

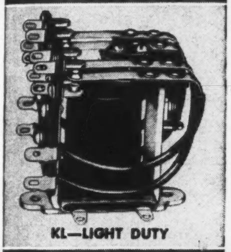



SM—SUPER MIDGET



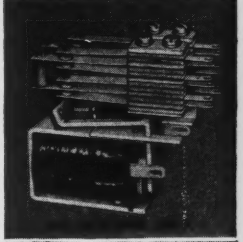

LP—PLATE




KL—LIGHT DUTY

KR—LIGHT DUTY

HG—MERCURY CONTACT



K CAN—OCTAL PLUG

M CAN—14 PRONG PLUG

## Potter & Brumfield

Leading supplier of relays to industry—for every electrical and electronic application.

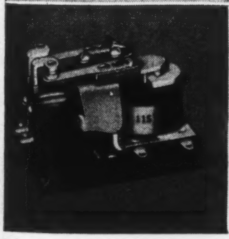
Specialists in design and manufacture of open and sealed relays for military equipment.

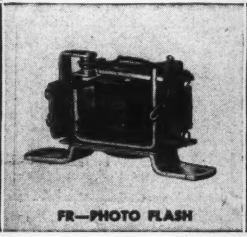
Write for 26 page catalog No. 109 describing numerous standard models. Send specifications for recommendations, samples and quotations.

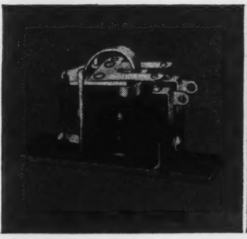
Contact your nearest P & B Sales Engineering Office:

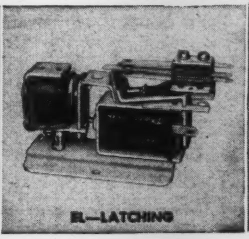
**ALBANY 7, NEW YORK, 100 State Street, Albany 3-3628**
**ALEXANDRIA, VIRGINIA, 122 N. Fayette Street, Temple 1718**
**ATLANTA 5, GEORGIA, 103 Miller Bldg., Hemlock 6161**
**BOSTON 16, MASS., 25 Huntington Avenue, Kenmore 6-5580**
**BUFFALO 2, NEW YORK, 1124 Prudential Bldg., Mohawk 9222**
**CEDAR RAPIDS, IOWA, 309 Guaranty Bldg., Phone: 40833**
**CHICAGO 34, ILLINOIS, 3352 N. Central Ave., Pensacola 6-6776**
**CLEVELAND 15, OHIO, 1836 Euclid Avenue, Main 1-1286**
**DALLAS 5, TEXAS, 7322 Marquette Ave., Emerson 6-6286**
**DAYTON 2, OHIO, 18 W. Monument Avenue, Hemlock 9661**
**DENVER 7, COLORADO, 5528 East Colfax Ave., Freemont 3067**
**DETROIT 35, MICHIGAN, 19481 James Couzens H'way, Vermont 8-3460**
**INDIANAPOLIS 1, INDIANA, 2208 E. Washington Street, Market 8517**
**KANSAS CITY 2, MISSOURI, 1010 Porter Building, Logan 9824**
**LOS ANGELES 6, CALIFORNIA, 2230 W. 11th St., Dunkirk 3-4197**
**MEMPHIS, TENNESSEE, 1336 Madison Avenue, Phone 2-1914**
**MILWAUKEE 3, WISCONSIN, 744 North 4th Street, Broadway 2-0517**
**MINNEAPOLIS 17, MINNESOTA, 5022 29th Avenue, South, Drexel 1895**
**NEW YORK 16, N. Y., 13 E. 40th St., Murray Hill 3-7585**
**PHILADELPHIA, PA., DREXEL HILL, 3611 Berry Ave., Clearbrook 9-0231**
**PITTSBURGH 19, PA., 600 Grant Street, Court 0131**
**SAN FRANCISCO 3, CALIF., 1234 Folsom Street, Market 1-4166**
**ST. LOUIS 5, MISSOURI, 311 Connor Building, Parkview 7622**
**SEATTLE 1, WASHINGTON, 2217 Fourth Ave., Main 3750**
**SYRACUSE 1, NEW YORK, P. O. Box 1224, Baldwinsville 662**
**TORONTO 13, ONT. CANADA, 2273 Danforth Avenue, Oxford 1127**
**VANCOUVER, B.C., CANADA, 132 W. Hastings St., Pacific 3195**
**WILMINGTON, NORTH CAROLINA, 4924 Oleander Drive, Phone: 5749**
**EXPORT: ROCKE INTERNATIONAL CORPORATION**
**13 East 40th Street • New York 16, N. Y., U. S. A.**

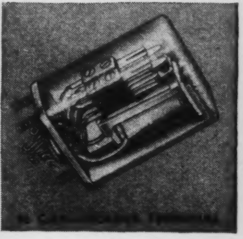
**POTTER & BRUMFIELD · PRINCETON, INDIANA · PHONE 1208**

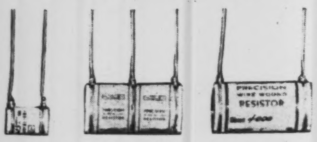



FR—PHOTO FLASH




EL—LATCHING





-COLE-

Precision Wire-wound
RESISTORS

Subminiature, miniature, standard and special types.

High stability and accuracy.

Furnished in all resistance tolerances, wound with various types of resistance wire and with all types of impregnation and treatments.

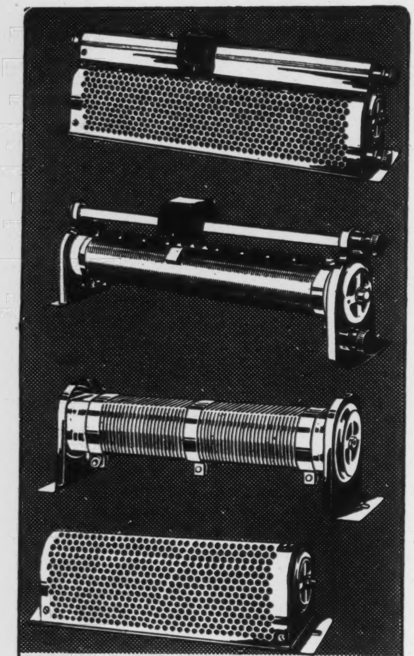
Resistance
Cards

Linear and Non-linear

Supplied to specifications in wide limits of configurations and sizes, to extremely close electrical and mechanical tolerances.

*Give Us Your Specifications*

COLE Instrument Co.
1320 S. Grand Ave., Los Angeles 15, Calif.



PROTECTED AND UNPROTECTED
SLIDE-CONTACT RHEOSTATS
AND RESISTORS 220 TO 1000 WATT

REX RHEOSTAT CO.
BALDWIN, L. I., N. Y.

*Just Published*

*A Romance in Research—*

The Life of
C. F. Burgess

By A. McQUEEN

With a Technical Appendix
by O. W. STOREY

*Cloth, 6" x 9", 430 pages*

$6.00 postpaid

*Cash, Check or Money Order must accompany orders.*

The Instruments Publishing
Company, Inc.
921 Ridge Avenue
Pittsburgh 12, Penna.

### RESISTANCES

Aerovox Corp.
Allen-Bradley Co.
Associated Research
Automatic Elec. Chicago
Beck Bros.
Central Scientific Co.
Clarostat Mfg. Co.
Cutler-Hammer, Inc.
Daven Co.
Electronic Dev. Lab.
General Elec. Co.
General Radio Co.
Gray Instrument
Instrument Resistors
International Resistance
Kay Electric
Leeds & Northrup
Mallory & Co.
Ohmite Mfg. Co.
**Precision Resistor Co.**
Resistance Products
Rubicon Co.
Sensitive Research Inst.
Shallcross Mfg. Co.
Sprogue Electric Co.
Van Dyke Instruments
Ward Leonard
Westinghouse Elec

### RESISTORS, Adjustable

Aerovox Corp.
Allen-Bradley Co.
Carter Parts Co.
Clarostat Mfg. Co
Cutler-Hammer, Inc
Daven Co.
De Jur-Amsco
Electro-Mec Lab.
General Radio Co.
Hardwick, Hindle, Inc.
Instrument Resistors Co.
International Resistance
Lectrohm Inc.
Leeds & Northrup
Lewis Engineering
Mallory & Co.
Model Engineering
Ohmite Mfg. Co.
Resistors, Inc.
Rex Rheostat Co.
Sprogue Electric Co.
Sticht Co.
Technology Instrument
Van Dyke Instrument
Walker-Jamieson, Inc.
Ward Leonard Electric Co.
Westinghouse Elec.

### RESISTORS, Carbon Composition

Allen-Bradley Co.
Beck Bros.
Jas. G. Biddle Co.

(Continued)

Eastern Specialty Co.
Eclipse-Pioneer Div.
Instrument Resistors
Keystone Carbon
Morganite, Inc.
Natl. Carbon Co., Inc.
Ohio Carbon Co.
Welch Scientific Co.

### RESISTORS, High Frequency

Beck Bros.
Clarke Inst. Corp.
Clarostat Mfg. Co.
Corning Glass Works
Daven Co.
Erie Resistor Corp.
General Elec. Co.
General Radio Co.
Hardwick, Hindle, Inc.
Instrument Resistors Co.
International Resistance
Kay Electric
Leeds & Northrup Co.
Madison Elec. Prod. Div.
Mallory & Co.
Measurements Corp.
Ohmite Mfg. Co.
Resistance Products Co.
Shallcross Mfg. Co.
Sprague Electric Co.
Technology Instrument
Ward Leonard Elec. Co.

### RESISTORS, High Voltage

Associated Research
Beck Bros.
Clarostat Mfg. Co.
Cole Instrument
Cutler-Hammer, Inc.
General Elec. Co.
Hardwick, Hindle, Inc.
Instrument Resistors Co.
International Resistance
**J B L Instrument Co.**
Kay Electric
Madison Elec. Prod. Div.
Mepco
Ohmite Mfg. Co.
Reiner Electronics
Resistance Products Co.
Sensitive Research Inst.
Shallcross Mfg. Co.
Simpson Electric Co.
Ward Leonard Electric Co.
Westinghouse Elec.
Weston Elec. Inst. Corp.

### RESISTORS, Manganin

Associated Research
Beck Bros.
Brown Electro-Measurement
Cole Instrument
Daven Co.
De Jur-Amsco
Electro-Mec Lab.
Electronic Dev. Lab.

(Continued)

Federal Instrument
General Radio Co.
Gray Instrument Co.
Hardwick, Hindle, Inc.
Instrument Resistors Co.
Leeds & Northrup Co.
Madison Elec. Prod. Div.
Mepco
Ohmite Mfg. Co.
Radio City Products
Reiner Electronics
Resistance Products Co.
Rubicon Co.
Sensitive Research Inst.
Shallcross Mfg. Co.
Van Dyke Instruments
Westinghouse Elec.

### RESISTORS, Molded

Aerovox Corp.
Allen-Bradley Co.
Beck Bros.
Clarostat Mfg. Co.
Erie Resistor Corp.
General Elec. Co.
Instrument Resistor Co.
International Resistance
Ohmite Mfg. Co.
Radio City Products
Reiner Electronics
Westinghouse Elec.

### RESISTORS, Negative Temperature Coefficient

Clarostat Mfg. Co.
Federal Telephone
Friez Instrument Div.
Keystone Carbon Co.
Rex Rheostat
Shallcross Mfg. Co.
Victory Engr.

### RESISTORS, Non-Inductive

Cinema Engr.
Clarostat Mfg. Co.
Cole Instrument
Daven Co.
Electro-Mec Lab.
General Radio
Hycor Co.
Kay Electric
Mepco
Ohmite Mfg.
Rex Rheostat
Shallcross Mfg. Co.
States Co.
Ward Leonard Electric
Western Radiation Lab.
Weston Elec. Inst.

### RESISTORS, Standard (See Standards, Resistance)

### RESISTORS, Variable

Aerovox Corp.
Allen Bradley Co.

(Continued)

Beck Bros.
Jas. G. Biddle Co.
Brown Electro-Measurement
Centralab Div.
Clarostat Mfg. Co.
Cutler-Hammer, Inc.
Daven Co.
De Jur-Amsco
Electro-Mec Lab.
Federal Instrument
Ford Engineering
General Elec. Co.
General Radio Co.
Gray Instrument Co.
Hardwick, Hindle, Inc.
Helipot Corp.
Instrument Resistors Co.
International Resistance
Lectrohm, Inc.
Leeds & Northrup Co.
Lewis Engineering
Mallory & Co.
Muter Co.
Natl. Elec. Controller
Ohmite Mfg. Co.
Resistors, Inc.
Rex Rheostat Co.
Rubicon Co.
Shallcross Mfg.
Sticht Co.
Technology Instrument
Van Dyke Instruments
Ward Leonard Electric

### RESISTORS, Wire Wound

Aerovox Corp.
Associated Research
Automatic Elec. Chicago
Beck Bros.
Biddle Co., Jas. G.
Borg Corp.
Brown Electro-Measurement
Carter Parts Co.
Clarostat Mfg. Co.
Cole Instrument
Cutler-Hammer, Inc.
Daven Co.
De Jur-Amsco
Electro-Mec Lab.
Electro-Tech. Equip.
Federal Instrument
General Elec. Co.
General Radio Co.
Gray Instrument Co.
Hardwick, Hindle, Inc.
Instrument Resistors Co.
International Resistance
Lectrohm, Inc.
Leeds & Northrup Co.
Madison Elec. Prod. Div.
Mallory & Co.
Mepco
Model Engineering
Muter Co.
National Electric Control

(Continued)

Ohmite Mfg. Co.
Resistance Prod. Co.
Resistors, Inc.
Rex Rheostat Co.
Rubicon Co.
Shallcross Mfg. Co.
Simpson Electric Co.
Sprague Electric Co.
Sticht Co.
Technology Instrument
Van Dyke Instruments
Ward Leonard Electric Co.
Westinghouse Elec.
Weston Elec. Inst. Corp.

### RHEOSTATS, Battery Charging

Allen-Bradley Co.
Beck Bros.
Centralab Div.
Clarostat Mfg. Co.
Cutler-Hammer, Inc.
De Jur-Amsco
Hardwick, Hindle, Inc.
International Resistance
Natl. Elec. Controller
Ohmite Mfg. Co.
Rex Rheostat Co.
Ward Leonard Elec. Co.

### RHEOSTATS, Field

Cutler-Hammer, Inc.
Dittmore & Freimuth
General Electric Co.
Ohmite Mfg. Co.
Ward Leonard Elec. Co.

### RHEOSTATS, Laboratory

Allen-Bradley Co.
American Inst. Co.
Beck Bros.
Beckman Inst.
Biddle Co., Jas. G.
Borg Corp.
Brown Electro-Measurement
Centralab Div.
Clarostat Mfg. Co.
Cole Instrument
De Jur-Amsco Corp.
Ford Engineering
Central Scientific Co.
Centralab Div.
Chicago Apparatus Co.
Clarostat Mfg. Co.
Daven Company
Eastern Specialty Co.
Electro-Mec Lab.
Electronic Associates
General Radio Co.
G-M Labs.
Gray Instrument Co.
Hardwick, Hindle, Inc.
**Helipot Corp.**
International Resistance
Mallory & Co.
Natl. Elec. Controller
Ohmite Mfg. Co.

(Continued)

Rex Rheostat Co.
Rubicon Co.
Schaefer Bros. Co.
Sticht Co.
Technology Instrument
Thwing-Albert Inst. Co.
Van Dyke Instruments
Ward-Leonard Elec. Co.

### RHEOSTATS, Meter Testing

Allen-Bradley Co.
Beck Bros.
Biddle Co., Jas. G.
Clarostat Mfg. Co.
Cole Instrument
Daven Co.
De Jur-Amsco Corp.
Eastern Specialty Co.
Gray Instrument Co.
International Resistance
Leeds & Northrup
Mallory & Co.
Natl. Elec. Controller
Ohmite Mfg. Co.
Rex Rheostat Co.
Shallcross Mfg.
States Co.
Ward Leonard Elec. Co.

### RHEOSTATS, Slide Wire

Beck Bros.
Beckman Inst.
Biddle Co., Jas. G.
Borg Corp.
Brown Electro-Measurement
Central Scientific Co.
Chicago Apparatus Co.
Clarostat Mfg. Co.
Cole Instrument
Cutler-Hammer, Inc.
Ford Engineering
General Radio Co.
Gray Instrument Co.
Hardwick, Hindle, Inc.
Helipot Corp.
Leeds & Northrup
Natl. Elec. Controller
Ohmite Mfg. Co.
Rex Rheostat Co.
Rubicon Co.
Shallcross Mfg. Co.
Sticht Co.
Technology Instrument
Thwing-Albert Inst. Co.
Van Dyke Instruments
Welch Scientific

### RIDEOMETERS, RIDE COMFORT Recorder & Riding-Quality Instruments

Calidyne Co.
Commercial Research
Impact Register Co.
Jaeger Watch Co.
Saxl Instrument
Sperry Products, Inc.

**ROTAMETERS (See Flowmeters, Area, Free Float Type)**

**RUBBER STOPPERS**
Rhodes Metaline Co.

**RULES, Adjustable Curve (See Drawing Instruments)**

**RULES, Aluminum**
Bowen & Co.
Keuffel & Esser Co.
Lufkin Rule Co.
Stratex Instrument Co.
Warren-Knight Co.

**RULES, Brass**
Bliss & Co.
Grammes & Sons
Lufkin Rule Co.
Mico Instrument Co.
Starrett Co.
Warren-Knight Co.

**RULES, Caliper**
American Measuring Inst.
Brown & Sharpe
Glogau & Co.
Lufkin Rule Co.
Millers Falls Co.
Starrett Co.
Warren-Knight Co.

**RULES, Drafting Room (See Drawing Instruments)**

**RULES, Folding**
Bliss & Co.
Dietzgen Co.
Keuffel & Esser Co.
Lufkin Rule Co.
Post Co., Frederick
Speidel & Co.
Starrett Co.
Stratex Instrument Co.
Warren-Knight Co.
Weber Co.
White Co., **David**

**RULES, Glass**
Fish-Schurman Co.
Dusenberry Co.
Electronic Products
Engineers Specialty Div.
Glass Engraving Co.
Kontes Glass Co.
Mann Co., W. I.
Mico Instrument Co.
Palos Optical Co.
Phoenix Prec. Inst.
Scientific Glass App.

**RULES, Parallel**
American Meas. Insts.
Bliss & Co.
Dietzgen Co.
Hamilton Mfg. Co.
Keuffel & Esser Co.
Lufkin Rule Co.
Négus, T. S. & J. D.
Palos Optical Co.
Speidel & Co.
Warren-Knight Co.
White Co., Inc.
Weber Co.

**RULES, Precision Standard**
Amer. Measuring Insts.
Bowen & Co.
Brown & Sharpe
Engineers Specialty Div.
Gaertner Scientific Corp.
Griswold Mfg. Co.
Lufkin Rule Co.
Starrett Co.

**RULES, Shrinkage**
**Brown & Sharpe**
**Keuffel & Esser Co.**
**Lufkin Rule Co.**
**Speidel & Co.**
**Starrett Co.**
**Warren-Knight Co.**
**Weber Co.**

**RULES, Slide (See Drawing Instruments)**

**RULES, Stainless Steel**
**Stafford Co.**
Starrett Co., L. S.

**RULES, Steel**
American Measuring Insts.
Bowen & Co.
Brown & Sharpe
Keuffel & Esser Co.
Lufkin Rule Co.
Mico Instrument Co.
Millers Falls Co.
Scherr Co., Inc.
Speidel & Co.
Starrett Co.
Warren-Knight Co.
Weber Co.

**RULES, Wood**
Henschel & Co.
Keuffel & Esser Co
Lufkin Rule Co.
Post Co., Frederick
Speidel & Co.
Warren-Knight Co
Weber Co.

**RUNNING TIME RECORDERS**
Aero Instrument
Alden Products
American Time Prod.
Bristol Co.
Cincinnati Time Rec.
Cramer Co., Inc.
General Electric
Gorrell & Gorrell
Marion Electrical Inst.
Westinghouse Elec.

**RUNNING TIME TOTALIZERS**
Aero Instrument
**Bristol Co.**
Cincinnati Time Rec.
Cramer Co., Inc.
Dale Instruments
Elec. Tachometer Corp.

(Continued)

General Electric
Gorrell & Gorrell
Haydon Co., A. W.
Jaeger Watch Co.
Lumenite Electronic
Production Instrument
Serdex, Inc.
Standard Elec. Time

**SACCHARIMETERS**
Aloe Co., A. S.
Bausch & Lomb Opt.
Central Scientific Co.
Griebel Co.
Jarrell-Ash Co.
Kimble Glass
Moeller Instrument Co.
Precision Thermometer
**Rieker Inst. Co.**
Rudolph & Sons
Sargent & Co.
Trerice Co.
Weksler Thermometer

**SACCHAROMETERS**
Central Scientific Co.
Fleischhauer & Son
Griebel Co.
G. M. Mfg. Co., Inc.
H. B. Inst. Co.
Kimble Glass Co.
Moeller Instrument Co.
Precision Therm. & Inst.
Rascher & Betzold
Rieker Inst. Co.
Ruehfel Co.
Scientific Inst. Co.
Tagliabue Div.
Taylor Inst. Cos.
Testrite Instrument Co.
Trerice Co.
**Wagner & Son**
Weksler Thermometer

**SALINITY INDICATORS**
Bendix Marine Products
Central Scientific Co.
Engineering Labs., Inc.
Fleischhauer & Son
Gerin Corp.
G. M. Mfg. Co., Inc.
Griebel Co.
H-B Inst. Co.
Industrial Insts., Inc.
Instrument Lab.
J-P-L Instrument
**Kahl Scientific Inst.**
Leeds & Northrup Co.
Moeller Inst. Co.
Precision Therm. & Inst.
Rascher & Betzold
Rubicon Co.
Ruehfel Co.
Scientific Inst. Co.
Tagliabue Div.
Taylor Inst. Cos.
Thwing Albert Inst. Co.
Trerice Co.
Weksler Thermometer
Wagner & Son
Westinghouse Elec.

**SALINOMETERS (See Salinity Indicators)**

**SAMPLER, Boiler Water**
Hagan Corp.
Tagliabue Div.

**SAMPLER, Oil**
Braun Corp.
Central Scientific Co.
Hoke, Inc.
Johnston & Jennings Co.
Precision Scientific
Proportioneers, Inc.
Refinery Supply Co.
Scientific Glass Apparatus
Shand & Jurs
Vapor Recovery Systems

**SAMPLERS, Oil Bottomhole**
Coleman Inst. & Mfg.
Hoke, Inc.
Precision Scientific
Ruska Inst. Corp.

**SAMPLER, Peat and Marl**
**Eberbach Corp.**

**SAMPLERS, Sewage**
Builders-Providence
Central Scientific Co.
Precision Scientific
Scientific Glass Apparatus
Thwing-Albert Inst.

**SAMPLERS, Silt**
Central Scientific Co.
Instruments Corp.
Leupold & Stevens

**SAMPLERS, Snow**
Leupold & Stevens

**SCALER, Geiger Muller (See Counters, Geiger Muller)**

**SCALES (See also object of Measurement and Control)**

**SCALES, Antimony Test**
Howe Scale Co.
Seederer-Kohlbusch, Inc.
Troemner, Henry

**SCALES, Automatic**
Automatic Scale Co.
Buffalo Scale Co.
Chatillon & Sons
Exact Weight Scale
Fairbanks, Morse & Co.
Gump Co.
Howe Scale Co.
International Bus. Mach.
Jacobs Bros. Co., Inc.
Merrick Scale Mfg. Co.
Monsell, J. R.
Porter, George K.
Richardson Scale Co.
Schaffer Poidometer Co.
Seedburo Equipment
Streeter-Amet Co.
Toledo Scale Co.
Triner Sales Co.
Wallace & Tiernan

**SCALES, Bag Filling**
**Automatic Scale Co.**
**Exact Weight Scale Co.**
**Fairbanks, Morse & Co.**
**Gump Co.**
**Howe Scale Co.**
**Jacobs Bros. Co.**
**Richardson Scale Co.**
**Seedburo Equipment**
**Toledo Scale Co.**

**SGALES, Basis Weight**
Amthor Testing Inst. Co.
**Becker Div., Christian**
Buffalo Scale Co.
Cady & Co., E. J.
Exact Scale Co.
Howe Scale Co.
Seederer-Kohlbusch
Testing Machines, Inc.
Thwing-Albert Instrument
Toledo Scale Co.
Triner Sales Co.

**SCALES, Bulk Weighing**
Automatic Scale
Becker Div., Christian
Buffalo Scale Co.
**Chatillon & Sons**
Conoflow Corp.
Emery Co., A. H.
Exact Weight Scale Co.
Fairbanks, Morse & Co.
Gump Co., B. F.
Howe Scale Co.
Jacobs Bros. Co.
Merrick Scale Mfg.
Monsell, J. R.
Richardson Scale Co.
**Schaffer Poidometer Co.**
Streeter-Amet Co.
Toledo Scale Co.
Triangle Package Mach.
Triner Sales Co.
Troemner, Henry

**SCALES, Cement Batching**
Buffalo Scale Co.
Chatillon & Sons
Exact Weight Scale Co.
Fairbanks, Morse & Co.
Howe Scale Co.
Richardson Scale Co.
Streeter-Amet Co.
Toledo Scale Co.
Triner Sales Co.

**SCALES, Checking**
Becker Div., Christian
Buffalo Scale Co.
Chatillon & Sons
Exact Weight Scale Co.
Fairbanks, Morse & Co.
Howe Scale Co.
Jacobs Bros. Co., Inc.
Merrick Scale Mfg. Co.
Richardson Scale Co.
Toledo Scale Co.
Triner Sales Co.

**SCALES, Classifying**
Chatillon & Sons
Exact Weight Scale Co.
Jacobs Bros. Co., Inc.
Merrick Scale Mfg. Co.
Toledo Scale Co.
Triner Sales Co.

**SCALES, Computing**
Amthor Testing Inst.
Exact Weight Scale
Howe Scale Co.
International Bus. Mach.
Jacobs Bros., Inc.
Toledo Scale Co.
Triner Sales Co.

**SCALES, Continuous Weighing**
Automatic Scale
Buffalo Scale Co.
Builders-Providence
Chatillon & Sons
Exact Weight Scale Co.
Fairbanks, Morse & Co.
Gump Co.
Jacobs Bros. Co.
Jeffrey Mfg. Co.
Merrick Scale Mfg. Co.
Monsell, J. R.
Omega Machine
Richardson Scale Co.
Schaffer Poidometer Co.
**Streeter-Amet Co.**
Toledo Scale Co.
Triangle Package Mach.
Wallace & Tiernan

**SCALES, Conveyor**
Builders-Providence
Chatillon & Sons
Exact Weight Scale Co.
Fairbanks, Morse & Co.
Howe Scale Co.
International Bus. Mach.
Merrick Scale Mfg. Co.
Monsell, J. R.
Omega Machine
Richardson Scale Co.
Schaffer Poidometer Co.
**Streeter-Amet Co.**
Toledo Scale Co.
Wallace & Tiernan

**SCALES, Counting**
Amthor Testing Inst. Co.
Buffalo Scale Co.
Chatillon & Sons
Exact Weight Scale Co.
Fairbanks, Morse & Co.
Howe Scale Co.
International Bus. Mach.
Jacobs Bros. Co.
Potter Instrument
Seederer-Kohlbusch
Toledo Scale Co.
Triner Sales Co.

**SCALES, Crane**
Baldwin Locomotive
Buffalo Scale Co.
Chatillon & Sons
Dillon & Co.
Emery Co., A. H.
Fairbanks, Morse & Co.
**Howe Scale Co.**
**Toledo Scale Co.**

**SCALES, Dairy**
Becker Div., Christian
Buffalo Scale Co.
Central Scientific Co.
Chatillon & Sons
Exact Weight Scale Co.
Fairbanks, Morse & Co.
Howe Scale Co.
Humboldt Mfg. Co.
International Bus. Mach.
Jacobs Bros. Co.
Streeter-Amet Co.
Toledo Scale Co.
Triner Sales Co.
Troemner, Henry

**SCALES, Differential**
Chatillon & Sons
Exact Weight Scale Co.
Fairbanks, Morse & Co.
Jacobs Bros. Co., Inc.
Monsell, J. R.
Thwing-Albert Instrument

**SCALES, Drawing (See Drawing Instruments)**

**SCALES, Dump**
Automatic Scale
Buffalo Scale Co.
Exact Weight Scale Co.
Fairbanks, Morse & Co.
Howe Scale Co.
Toledo Scale Co.

**SCALES, Dynamometer**
Automatic Temp. Control
Baldwin Locomotive
Central Scientific Co.
Chatillon & Sons
Conoflow Corp.
Dillon & Co.
Emery Co., A. H.
Exact Weight Scale
Fairbanks, Morse & Co.
Hagan Corp.
Howe Scale Co.
Monsell, J. R.
Republic Flow Meters
Seederer-Kohlbusch, Inc.
Stoelting Co., C. N.
Taller & Cooper
Toledo Scale Co.

**SCALES, Estimating**
Exact Weight Scale Co.
Jacobs Bros. Co.
Seederer-Kohlbusch, Inc.
Troemner, Henry

**SCALES, Grain & Seed Testing**
Amthor Testing Inst. Co.
Automatic Scale Co.
Becker Div., Christian
Buffalo Scale Co.
Central Scientific Co.
Chatillon & Sons
Cuthbert Co.
Exact Weight Scale Co.
Fairbanks, Morse & Co.
Fisher Scientific Co.
Gump Co.
Howe Scale Co.
Jacobs Bros. Co.
Richardson Scale Co.
Seedburo Equipment
Streeter-Amet Co.
Toledo Scale Co.
Triangle Package Mach.
Triner Sales Co.
Troemner, Henry

**SCALES, Hopper**
Buffalo Scale Co.
Chatillon & Sons
Exact Weight Scale
Fairbanks, Morse & Co.
Gump Co.
Howe Scale Co.
Jacobs Bros. Co.
Richardson Scale Co.
Seedburo Equipment
Streeter-Amet Co.
Toledo Scale Co.

**SCALES, Laboratory**
Becker Div., Christian
Buffalo Scale Co.
Central Scientific Co.
Chatillon & Sons
Chicago Apparatus Co.
Clay-Adams Co.
Dietert Co.
Eberbach & Son
Exact Weight Scale Co.
Fairbanks, Morse & Co.
Fisher-Scientific Co.
General Biological
Goetze Niemer Co.
Howe Scale Co.
Humboldt Mfg. Co.
International Bus. Mach.
Jacobs Bros. Co.
Microchemical Service
Seedburo Equipment
Seederer-Kohlbusch, Inc.
Thompson Balance
Toledo Scale Co.
Troemner, Henry
Voland & Sons

**SCALES, Larry Car**
Buffalo Scale Co.
Fairbanks, Morse & Co.
Howe Scale Co.
Richardson Scale Co.
Streeter-Amet Co.
Toledo Scale Co.

**SCALES, Liquid**
Exact Weight Scale Co.
Howe Scale Co.
Jacobs Bros. Co., Inc.
Merrick Scale Mfg.
Monsell, J. R.
Richardson Scale Co.
Toledo Scale Co

**SCALES, Sacking (See Scales, Bag-Filling)**

**SCALES, Loss of Weight**
**Becker Div., Christian**
**Buffalo Scale Co.**
**Builders-Providence**
**Dietert Co.**
**Exact Weight Scale Co.**
**Jacobs Bros. Co.**
Monsell, J. R.
**Omega Machine**
**Proportioneers, Inc.**
Seederer-Kohlbusch, Inc.
Streeter-Amet Co.
Thwing-Albert Inst.
Toledo Scale Co.

**SCALES, Mud**
Chatillon & Sons

**SCALES, Over & Under**
**Automatic Scale**
**Becker Div., Christian**
**Buffalo Scale Co.**
**Exact Weight Scale Co.**
**Fairbanks, Morse & Co.**
**Howe Scale Co.**
**International Bus. Mach.**
**Jacobs Bros. Co.**
**Moisture Register Co.**
**Seedburo Equipment**
Streeter-Amet. Co.
Toledo Scale Co.
Triner Sales Co.
Troemner, Henry

**SCALES, Packaging**
Automatic Scale Co.
Chatillon & Sons
Exact Weight Scale Co.
Fairbanks, Morse & Co.
Gump Co.
Howe Scale Co.
International Bus. Mach.
Jacobs Bros. Co.
Monsell, J. R.
Richardson Scale Co.
Toledo Scale Co.
Triangle Package Mach.
Triner Sales Co.
Troemner, Henry

**SCALES, Platform**
Becker Div., Christian
Buffalo Scale Co.
Chatillon & Sons
Exact Weight Scale Co.
Fairbanks, Morse & Co.
Gump Co.
Howe Scale Co.
Humboldt Mfg. Co.
International Bus. Mach.
Monsell, J. R.
**Seedburo Equipment**
Streeter-Amet Co.
Toledo Scale Co.
Triner Sales Co.

**SCALES, Portable**
**Black & Decker**
Buffalo Scale Co.
Central Scientific Co.
Chatillon & Sons
Dillon & Co.
Exact Weight Scale Co.
Fairbanks, Morse & Co.
Gump Co.
Howe Scale Co.
International Bus. Mach.
Jacobs Bros. Co.
Kron Co.
Richardson Scale Co.
Seedburo Equipment
Streeter-Amet Co.
Toledo Scale Co.
Triner Sales Co.
Voland & Sons

**SCALES, Predetermined Weight**
Automatic Scale
Buffalo Scale Co.
Exact Weight Scale Co.
Fairbanks, Morse, & Co.
Gump Co.
Howe Scale Co.
International Bus. Mach.
Jacobs Bros. Co.
Merrick Scale Mfg. Co.
Monsell, J. R.
Richardson Scale Co.
Schaffer Poidometer Co.
Seederer-Kohlbusch, Inc.
Streeter-Amet Co.
Toledo Scale Co.
Triner Sales Co.

**SCALES, Recording**
Automatic Temp. Control
Buffalo Scale Co.
Fairbanks, Morse & Co.
Hagan Corp.
Howe Scale Co.
Merrick Scale Mfg. Co.
Minnesota Electronics
Monsell, J. R.
Richardson Scale Co.
Streeter-Amet Co.
Taller & Cooper
Toledo Scale Co.
Wallace & Tiernan

**SCALES, Remote Indicating**
Automatic Temp. Control
Conoflow Corp.
Dillon & Co.
Emery Co., A. H.
Exact Weight Scale Co.
Howe Scale Co.
Merrick Scale Mfg.
Monsell, J. R.
Republic Flow Meters
Streeter-Amet Co.
Taller & Cooper
Toledo Scale Co.

**SCALES, Rolling Mill**
**Buffalo Scale Co.**
**Fairbanks, Morse & Co.**
**Howe Scale Co.**
Streeter-Amet Co.
**Toledo Scale Co.**

**SCALES, Selecting**
**Exact Weight Scale**
**Howe Scale Co.**
**Merrick Scale Mfg.**
**Toledo Scale Co.**

**SCALES, Solder Test**
Central Scientific Co.
Exact Weight Scale
Seederer-Kohlbusch, Inc.
Troemner, Henry

**SCALES, Steel**
American Meas. Insts.
Dillon & Co.
Exact Weight Scale Co.
Fairbanks, Morse & Co.
Howe Scale Co.
Lufkin Rule Co.
Streeter-Amet Co.
Toledo Scale Co.

**SCALES, Testing**
Buffalo Scale Co.
Chatillon & Sons
Dillon & Co.
Eberbach & Sons
Exact Weight Scale
Gump Co.
Howe Scale Co.
Humboldt Mfg. Co.
Jacobs Bros. Co.
Newark Scale Works
Seedburo Equipment
Taller & Cooper
Toledo Scale Co.

**SCALES, Textile**
Becker Div., Christian
Buffalo Scale Co.
Chatillon & Sons
Exact Weight Scale Co.
Fairbanks, Morse & Co.
Howe Scale Co.
International Bus. Mach.
Seederer-Kohlbusch, Inc.
Streeter-Amet Co.
Suter, Alfred
Toledo Scale Co.
Triner Sales Co.

**SCALES, Track**
Baldwin Locomotive
Buffalo Scale Co.
Emery Co., A. H.
Fairbanks, Morse & Co.
Howe Scale Co.
Streeter-Amet Co.
Toledo Scale Co.

**SCALES, Truck**
Black & Decker
Buffalo Scale Co.
Exact Weight Scale Co.
Fairbanks, Morse & Co.,
Howe Scale Co.
Seedburo Equipment
Streeter-Amet Co.
Toledo Scale Co.

**SCALES, Water Meter**
Alteneder & Sons
Exact Weight Scale
Fairbanks, Morse & Co.
Jacobs Bros. Co.
Toledo Scale Co.

**SCALES, Yardage**
Amthor Testing Inst.
Brown & Sharpe
Buffalo Scale Co.
**Exact Weight Scale**
**Fairbanks, Morse & Co.**
Howe Scale Co.
International Bus. Mach.
Toledo Scale Co.

**SCREENS, Solar Projecting**
Fecker, Inc.

**SCREENS, X-Ray Fluoroscopic**
Canadian Radium
Eastman Kodak Co.
General Elec. X-Ray Dept.
General Luminescent
Goetze-Niemer Co.
Kelley-Koett Mfg. Co.
North American Philips
Patterson Screen Div.
Picker X-Ray
Stoelting Co., C. H.
U. S. Radium Corp.
Westinghouse X-Ray Co.

**SCREENS, X-RAY Intensifying (See Screens X-Ray Fluorescopic)**

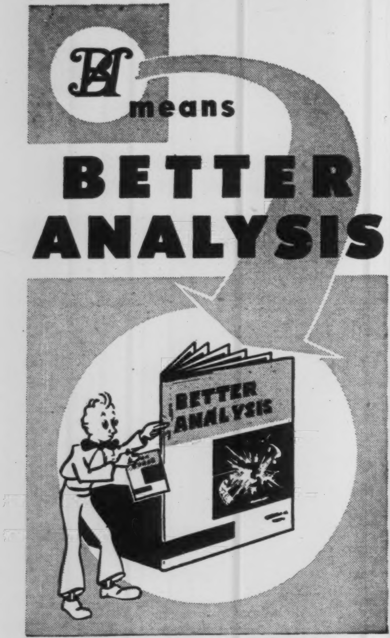
**SEED SIEVE SETS**
Ballauf Mfg. Co.
Seedburo Equipment

**SEGER CONES (See Cones, Pyrometric)**

**SEISMOGRAPHS**
Alpha Instrument Co.
American Inst. Co.
Brown Geophysical
Century Geophysical
Coleman Inst. & Mfg
Consolidated Engg.
Engineering Labs., Inc.
Geophysical Instrument
Gilman Scientific
Hathaway Instrument
Henson Co., Fred C.
Heiland Research Corp.
Martin-Hubbard Corp.
Mico Instrument Co.
Southwestern Ind. Elec.
Sprengnether Instrument

**SELF-OPERATING CONTROLLERS & REGULATORS, AUTOMATIC**
American Inst. Co.
Area Regulators, Inc.
Atlas Valve Co.
Automatic Elec. Chicago
Bailey Meter Co.
Bastian-Blessing
Beck Co.
Betts & Betts
Bristol Co.
Brooke Engineering

(Continued)



INSTRUMENTS
for
MEASUREMENT
and
CONTROL

1. DIRECT READING SPECTROMETER (Metals)
2. RECORDING SPECTROPHOTOMETER (Organic and Inorganic)
3. 3 METER SPECTROGRAPH (Inorganic Analysis)
4. SOURCE POWER PANEL (Emission Spectroscopy)
5. GAS ANALYZER (Continuous Plant Analysis)

Principals in the chemical process industries, in metals, in government, etc., may avail themselves of technical bulletins of the major Baird Associates instruments or be put on the mailing list to receive BETTER ANALYSIS, periodic review of instrumentation by writing on their letterhead to

Baird Associates Inc.
33 University Road Cambridge 38, Mass.

Climax Div.
Cutler-Hammer, Inc.
Dickson Co.
Elec. Indicator Corp.
Fischer & Porter
Fisher-Pierce Co.
Flight Research Eng.
Foxboro Co.
Kiely & Mueller
Leeds & Northrup Co.
Leslie Co.
Leupold & Stevens
Magnetrol Inc.
Manning, Maxwell & Moore
Martin-Hubbard Corp.
Mason-Neilan Regulator
Minneapolis-Honeywell
Mosher Electronics
Partlow Corp.
Perfex Corp.
Robinette Co.
Sarco Co., Inc.
Schade Valve Mfg. Co.
Scientific Inst. Co.
Seely Inst. Co.
Shallcross Controls
Tagliabue Div.
Taylor Inst. Cos.
Trerice Co.
Vapor Recovery Systems
Vectron, Inc.
Wheelco Instruments

### SERVOMOTORS, Electric Motor

Arma Corporation
Automatic Temp. Control
Barber-Colman
Beck Co.
Collins Radio
Doelcam Corp.
Eclipse-Pioneer Div.
Electric Indicator
Electronic Associates
Fairchild Camera
Ford Instrument
General Elec. Co.
General Regulator Corp.
Hansen Mfg. Co.
L. A. B. Corp.
Lear, Inc.
Leeds & Northrup
Martin-Hubbard Corp.
Maxson Corp.
Minneapolis-Honeywell
Oster Mfg., John
Reeves Instrument
Robinette Co., W. C.
Schwien Engg.
Servo Corp. of America
Servomechanisms, Inc.
Shallcross Controls
Sperry Gyroscope Co.
Summers Gyroscope
Wilson & Co.

### SERVOMOTORS, Electric Solenoid

Clark Cooper Co.
Instrument Dev. Labs.
Martin-Hubbard Corp.
Ruggles-Klingemann
Schwien Eng. Co.
Servo Corp. of Amer.
Shallcross Controls
Summers Gyroscope

### SERVOMOTORS, Hydraulic

Askania Regulator Co.
Bailey Meter Co.
Cash Co.
Dennison Engineering
General Electric
General Regulator Corp.
Hagan Corp.
Martin-Hubbard Corp.
Mason-Neilan Regulator
Maxson Corp.
Republic Flow Meters
Servo Corp. of Amer.
Shallcross Controls

### SERVOMOTORS, Mechanical

Airflo Instrument Co.
Foxboro Co.
Hagan Corp.
Lears, Inc.
Martin-Hubbard Corp.
Servo Corp. of America
Servomechanisms, Inc.
Summers Gyroscope

### SERVOMOTORS, Pneumatic

Askania Regulator Co.
Bailey Meter Co.
Cash Co.
Emery Co., A. H.
Hagan Corp.
Mason-Neilan Regulator
Maxson Corp.
Minneapolis-Honeywell
Moore Products
Republic Flow Meters
Servo Corp. of Amer.

### SEXTANTS

Alpha Instrument Co.
Bausch & Lomb Opt.
Bray Optical Co.
Dusenbery Co.
Eclipse-Pioneer Div.
Fairchild Camera
Keuffel & Esser Co.
Leupold & Stevens
Link Aviation Devices
Negus, T. S. & J. D.
Suverkop Instruments
Unertl Optical Co.
Warren-Knight Co.
White Co., Inc.

### SHIP LOGS

Elec. Tachometer Corp.
Kenyon Instrument Co.
Negus, T. S. & J. D.
Pitometer Log Corp

### SHOCK MOUNTINGS (See Mountings)

### SHUNT METERS (See Meters, Shunt)

### SHUNTS

Associated Research
Bradshaw
Burlington Inst Co.
Cole Instrument
Columbia Elec. Mfg.
De Jur-Amsco
Electronic Dev. Lab.
Esterline-Angus Co.
General Elec. Co.
Gray Instrument
Hickok Elec. Inst. Co.
Instrument Resistors, Inc.
International Resistance
Leeds & Northrup
Lewis Engineering
Madison Elec. Prod. Div.
Norton Electrical Inst.
Precision Resistor Co.
Radio City Products Co.
Rawson Electrical Inst.
Reiner Electronics
Roller-Smith Co.
Rubicon Co.
Sangamo Electric
Sensitive Research Inst.
Shallcross Mfg.
Standard Science Sup.
Simpson Electric Co.
Sun Manufacturing
Triplett Electrical Inst.
Westinghouse Elec.
Weston Elec. Inst. Corp.
Winslow Co.

### SHUNTS, Standard

Associated Research
Cambridge Instrument Co.
Cole Instrument
De Jur-Amsco
Electronic Dev. Lab.
General Electric Co.
Gray Instrument Co.
Hickok Electrical Inst.
Instrument Resistors Co.
International Resistance
Leeds & Northrup Co.
Lewis Engineering
Roller-Smith Co.
Rubicon Co.
Sensitive Research Inst.
Shallcross Mfg.
Triplett Elec. Inst. Co.
Weston Elec. Inst. Corp.
Winslow Co.

### SIEVE SHAKERS

American Inst. Co.
Braun Corp.
Central Scientific
Dietert Co.
Humboldt Mfg. Co.
Newark Wire Cloth
Precision Scientific
Williams Apparatus

### SIEVES, TESTING

American Inst. Co.
Central Scientific Co.
Dietert Co.
Fisher Scientific Co.
Humboldt Mfg. Co.
Newark Wire Cloth
Precision Scientific Co.
Riehle Division
Scientific Inst. Co.
Weber Brothers Metal

### SIGHT FEED BUBBLERS

Bailey Meter Co
Brooks Rotameter
Fischer & Porter
Industrol Corp.
Meriam Instrument
Moore Products

### SIGHT METERS

De Jur-Amsco
General Elec. Co.
G-M Labs.
Triplett Elec. Inst.
Weston Elec. Inst. Corp.

### SIGHTS, GUN, Telescopic

Bausch & Lomb Opt.
Bell & Howell Co.
Clark & Sons
Fecker, Inc.
Kollmorgan Optical Co.
Leupold & Stevens
Palos Optical Co.
Perkin-Elmer Co.
Plummer & Kershaw
Unertl Optical Co.
Zeiss, Inc., Carl

### SIGNAL GENERATORS (See Generators, Signal)

### SIGNALING DEVICES Automatic

Auth Elec. Spec.
Autocall Co.
Automatic Elec. Chicago
Automatic Elec. Mfg.
Automatic Temp. Controls
Bailey Meter Co.
Beck & Co.
Betts & Betts
Browning Labs.
Bullard Co.
Cannon Electric
Cincinnati Time Rec.
Clark Cooper Co.
Dorothea Mechanisms, Gale
Eastern Industries
Elec. Indicator Corp.
Fischer & Porter
Foxboro Co.
General Elec. Co.
Guardian Elec. Mfg. Co.
Haydon Co., A. W.
Holtzer-Cabot Elec. Co.
Industrial Timer Corp.

(Continued)

International Bus. Mach.
Leslie Co.
Leupold & Stevens
Lumenite Co.
Magnetrol, Inc.
Martin-Hubbard Co.
Mine Safety App. Co.
National Time & Signal
Panellit, Inc.
Photoswitch, Inc.
Production Instrument
Rochester Mfg. Co.
Rosen Engg.
Spence Engineering Co.
Standard Elec. Time
Thompson Clock Co.
Viking Instruments
Wallace & Tiernan
Warren Telechron
Wheelco Instruments

### SIGNALING DEVICES, Traffic

Am. Gas Accumulator
Automatic Elec. Sales
Automatic Temp. Control
Bullard Co.
Eagle Signal Corp.
Eastern Industries
Edison Electrical Controls
General Elec. Co.
Menlo Research Lab.
National Time & Signal
Photoswitch, Inc.
Sangamo Electric Co.

### SILICA, VITREOUS

Crystal Research Labs.
Engelhard, Charles
General Electric
Thermal Syndicate, Ltd.

### SINE BARS

DoAll Co.
Herkimer Tool
Jansson Gage Co.
Swedish Gage Co.
Thomas Tool
Vinco Corp.

### SLIDE RULES (See Drawing Instruments)

### SLIDING GAGES (See Gages, Sliding)

### SLOW MOTION STUDY EQUIPMENT

Annis Co.
Bolsey Corp.
Boulin Instrument Corp.
Commercial Engg. Labs.
General Radio Co.
Telechron, Inc.

### SLUMP CONES (See Cones, Slump)

### SMOKE DENSITY, Indicators & Recorders

Ace Instrument Co.
Airdesign, Inc.
Associated Research
Bailey Meter Co.
Bristol Co.
Brooke Engineering
Cole Instrument
Denver Fire Clay Co.
De-Tec-Tronic Labs.
Dickson Co.
Edwards, L. V.
Electronic Lab.
Ess Instrument Co.
General Elec. Co.
General Power Plant
General Television Corp.
Leeds & Northrup Co.
Lumenite Elec.
McNeill Engineering
Photoswitch, Inc.
Photovolt Corp.
Preferred Utilities Mfg.
Refinery Supply
Rockwell Engr. Co.
Thwing-Albert Inst. Co.
Weston Elec. Inst. Corp.
Worner Electronics

### SMOOTHNESS RECORDERS (See Surface Finish Analyzers)

### SOLAR PROJECTING SCREENS (See Screen, Solar Projecting)

### SOLDERING IRONS

Stafford Co.
Hexacon Electric

### SOUND INDICATORS & ANALYZERS (See Indicators, Sound & Analyzers, Sound)

### SOUND LEVEL METERS

Amplifier Co.
Assembly Products
Audio Development
Audio-Tone Oscillator
Ballantine Labs.
Burlington Inst. Co.
Clough-Brengle Co.
Cole Instrument
Dale Instruments
Daven Co.
De Jur-Amsco Corp.
Dittmore & Freimuth
Electro-Tech Equipment
Electronic Development
Electronic Instrument
Feiler Engineering
General Elec. Co.
General Radio Co.
Hickok Elec. Inst.

(Continued)

Kay Electric Co.
Marion Electrical Inst.
Massa Labs.
Meters, Inc.
Precision Apparatus Corp.
Radio City Products Co.
RCA Div.
Scott, Inc., Hermon
Shallcross Mfg. Co.
Sherron Metallic
Simpson Electric
Sound Apparatus Co.
Techno Inst.
Triplett Electric Inst.
Viking Instruments
Westinghouse Elec.
Weston Elec. Inst. Corp.

### SOUNDING LEADS

Bliss & Co.
G. M. Mfg. Co.
Kenyon Instrument Co.
Moeller Instrument Co.
Negus, T. S. & J. D.

### SOUNDING MACHINES

Bendix Marine Products
G. M. Mfg. Co.
Hand & Sons
Kenyon Instrument Co.
Moeller Instrument Co.
Negus, T. S. & J. D.

### SOUNDING TUBES

Kimble Glass Co.
Leupold & Stevens
Moeller Instrument Co.
Negus, T. S. & J. D.

### SPECIFIC GRAVITY Indicators & Recorders (See Gravity)

### SPECTRAL TUBES CONTAINING RARE GASES (See Spectrum Tubes)

### SPECTROGRAPHS

Applied Research Labs.
Baird Associates
Bausch & Lomb Optical
Biddle Co., James G.
Farrand Optical
Fecker, Inc.
Gaertner Scientific Corp.
Heinrich Co., Carl
Henson Co., Fred C.
Jarrell-Ash
Precise Measurements Co.
Spencer Lens Co.
Unertl Optical Co.
Zeiss, Inc., Carl

### SPECTROGRAPHS, Mass

Berkeley Scientific
Furst Electronics
General Electric Co.
Process & Instruments
Phoenix Precision Insts.
Skaneateles Mfg. Co.

### SPECTROGRAPHS, Oscillating

General Elec. Co.
Hayes Scientific App.
Unertl Optical Co.

### SPECTROGRAPHS, Raman

Jarrell-Ash Co.
Lane-Wells Co.

### SPECTROGRAPHS, Vacuum

Baird Associates
Biddle Co., James G.
Central Scientific Co.
Dietert Co.
Farrand Optical
Fecker, J. W.
Jarrell-Ash Co.
Skaneateles Mfg. Co.
Thomas Co., Arthur H.
Unertl Optical Co.

### SPECTROGRAPHS, X-ray

Biddle Co., James G.
Central Scientific Co.
Gaertner Scientific
General Elec. X-Ray Dept.
Hayes Scientific App.
Henson Co., Fred C.
Jarrell-Ash Co.
Kelley-Koett Mfg.
North Amer. Philips
Unertl Optical Co.
Victoreen Instrument Co.
Wyland, G. C.

### SPECTROMETERS

American Optical
Applied Research Labs.
Baird Associates
Bausch & Lomb Optical
Beckman Instruments
Consolidated Engg.
Dearborn Scientific
Farrand Optical Co.
Gaertner Scientific Corp.
Jarrell-Ash Co.
Martin-Hubbard Corp.
Perkin-Elmer Corp.
Precise Measurements
Rudolph & Sons
Unertl Optical Co.
Welch Scientific

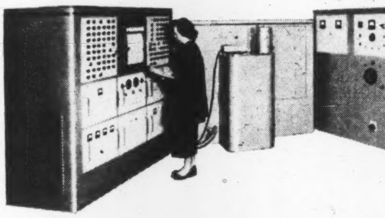
### SPECTROMETERS, Infra-Red

Baird Associates
Beckman Instruments
Farrand Optical
Gaertner Scientific Corp.
General Elec. Co.
Jarrel-Ash. Co.
Perkin-Elmer Corp.
Pfaltz & Bauer
Phoenix Prec. Inst.

# SPECTROGRAPHERS—

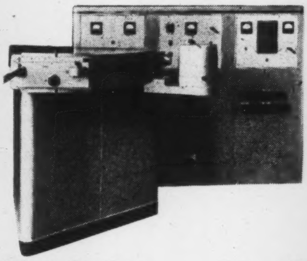
## choose your spectrochemical equipment from the most complete line.

**ARL offers you the most advanced types of instruments and related equipment.**



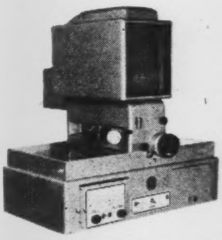
**Production Control Quantometer analyzes metals in two minutes**

Multipurpose, direct-reading spectrometer for quantitative analysis of inorganic samples. Instrument will give quantitative determinations of as many as 25 elements as selected by the user—up to 20 simultaneously. Designed for routine production control and research analysis. Each instrument is designed to meet your specific analytical requirements.



**Original Grating Spectrographs— 1.5 and 2 Meters.**

Extremely compact and versatile. Uniform dispersion over entire spectrum range. Original grating gives marked superiority in detecting elements in low concentrations. Paschen mounting for camera covers extensive spectrum range. Excitation stand accomodates flat and pin samples for both quantitative and qualitative analyses.



**Film Comparator-Densitometer— Easy to identify and measure density of spectrograms.**

This instrument is manufactured to the highest ARL standards, permitting the most accurate qualitative and quantitative analyses, based upon spectrum line positions and densities. It is easy to adjust and the image is located in a non-fatiguing position. As many as 6 lines per minute can be easily read.

The ARL line, manufactured by the world's largest producer of this type of equipment, also includes Source Units and related Spectrochemical accessories. Write today for complete details.

***Applied Research Laboratories***

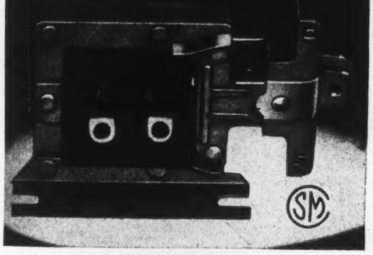
SPECTROCHEMICAL EQUIPMENT

4336 SAN FERNANDO ROAD • GLENDALE 4, CALIFORNIA

NEW YORK • PITTSBURGH • DETROIT • CHICAGO • LOS ANGELES

---

# SORENG



## SOLENOIDS for Instruments

Need electrically-actuated movement in your instruments? Look to Soreng for dependable solenoids at low cost. For maximum operating efficiency, Soreng Solenoids incorporate exclusive design features that assure more work per unit volume. Engineered to meet your exact requirements. Can be furnished for intermittent or constant duty on a-c or d-c. Pull and stroke are furnished as determined by your needs. Want more information? Write, without obligation, to Dept. U19.

*America's Largest Manufacturer of Solenoids*

**SORENG MANUFACTURING CORPORATION**

9555 Eden Ave., Schiller Park, Ill. (Chicago Suburb)
Plants: Schiller Park, Ill. • Fremont, Ohio

---

# MICROSYNS

Position Indicator
Type 1C-001A

The Doelcam Microsyn is an electro-magnetic four pole, reluctance bridge unit providing rugged construction, inherent electrical and mechanical simplicity, and high accuracy performance in the following applications:

| | |
|---|---|
| **Position Indicator** | provides an electrical indication of angular displacement with high signal-to-noise ratio. |
| **Stiffness Motor** | operates as a torsional spring with adjustable stiffness coefficient. |
| **Torque Generator** | supplies a torque proportional to excitation and independent of shaft rotation. |
| **Variable Inductor** | offers an inductance that varies linearly with shaft rotation. |

The Doelcam Microsyn can be designed for special applications in a wide variety of sizes. Units are available in instrument housings or as rotor and stator combinations to provide for individual mounting.

For more details, write to:

**DOELCAM CORPORATION**

56 Elmwood Street, Newton 58, Massachusetts.

*Gyroscopic Flight Test and Control Instrumentation*

SYNCHROS · SERVOMECHANISMS · MICROSYNS · ELECTRONIC INVERTERS

WESTACH
SPEED INDICATORS

1000
2000
3000
4000
5000
6000
R.P.M.

Speed Indicators in sizes 3½", 6", 20" with Senders for all industrial and engine speed applications. Send for catalog.

WESTBERG MFG. CO.
6535 No. Olmsted Chicago 31, Ill.

**SPECTROMETERS, Recording, Mass**
Berkley Scientific
Consolidated Engg.
Furst Electronics
General Elec. Co.
Process & Instruments
Unertl Optical Co.

**SPECTROMETERS, X-RAY (See Spectrograph, X-Ray)**

**SPECTRO-PHOTOMETERS (See Photometers, Spectro)**

**SPECTROPHOTOMETERS, Ultra-Violet**
Applied Physics Corp.
Farrand Optical
General Elec. Co.
Jarrell-Ash Co.
Librascope
Phoenix Precision Inst.

**SPECTROSCOPES**
American Optical
Bausch & Lomb Opt.
Central Scientific Co.
Dearborn Scientific
Fecker, Inc.
Fish-Schurman Corp.
Gaertner Scientific Corp.
General Elect. X-Ray
Jarrell-Ash Co.
Laboratory Specialties
Leitz, Inc.
Precise Measurements Co.
Rudolph & Sons
Unertl Optical Co.
Welch Scientific

**SPECTROSCOPE, Quartz**
Gaertner Scientific Corp.
Precise Measurements Co.
Unertl Optical Co.

**SPECTROSCOPES, Stellar**
American Optical Co.
Central Scientific Co.
Eastern Scientific Co.
Fecker, Inc.
Mico Instrument Co.
Perkins-Elmer Corp.
Unertl Optical Co.
Zeiss, Inc., Carl

**SPECTRUM TUBES**
Central Scientific Co.
Gaertner Scientific Corp.
General Physical Lab.
Jarrell-Ash Co.
Skaneateles Mfg. Co.

**SPEED, Indicators**
Anithor Testing Inst. Co.
Associated Research
Automatic Elec. Chicago
Bailey Meter Co.
Biddle Co., Jas. G.
Boulin Instrument Corp.
Bristol Co.
Brown & Sharpe
Chicago Elec. Tachometer
Cincinnati Time Rec.
Cole Instrument
Commercial Research
Cramer & Co., Inc.
Electric-Speed Ind. Co.
Elec. Tachometer Corp.
Elgin National Watch
Engineering Res. Dev.
Esterline-Angus Co.
Foxboro Co
Gaertner Scientific Corp
General Elec. Co.
General Radio
Hasler-Tel. Co.
Hastings Inst. Co.
Hathaway Inst. Co.
Hickok Elec. Inst. Co.
Jaeger Watch Co.
Jones-Motrola
Kay Electric
Leeds & Northrup Co.
Manning, Maxwell & Moore
McDonnell Odometer Co.
Metron Instrument Co.
Minneapolis-Honeywell
Moisture Register Co.
Potter Instrument
Precision Therm.
Roller-Smith
Sangamo Electric Co.
Scherr Co., Inc.
Simpson Electric
Standard Elec. Time
Starrett Co.
Sticht Co.
Triplett Elec. Inst.
U. S. Taximeter
Veeder-Root, Inc.
Walkirt Co.
Westberg Mfg. Co.
Westinghouse Elec.
Weston Elec. Inst. Corp.
Zernickow Co., O.

**SPEED, Recorders (See Speed Indicators)**

**SPEED, Regulators (See Controllers, Automatic, Tachometric)**

**SPEED SYNCHRONIZING INDICATORS**
Cole Instrument
Electric Speed Ind. Co.
Electric Tachometer
General Elec. Co.
Potter Instrument
Westberg Mfg. Co.

**SPEEDOMETERS**
Boulin Insrument Corp.
Central Scientific
Commercial Research
Corbin Screw Corp.
Cramer & Co., Inc.
Electric Auto-lite
Elec. Tachometer Corp.
Electronic Associates
Engineering Res. & Dev.
General Elec. Co.
Jones-Motrola
Stewart-Warner Corp.
Westinghouse Elec.

**SPHEROMETERS**
Engis Equipment
Gaertner Scientific
Mann Co., W. I.

**SPHYGMOMANOMETERS**
Cambridge Inst. Co.
G. M. Mfg. Co.
Hellige, Inc.
Precision Thermometer
Stoelting Co., C. H.
Taylor Inst. Cos.

**SQUARES, Combination & Machinists'**
Brown & Sharpe
DoAll Co.
Jansson Gage Co.
Lufkin Rule Co.
Mico Instrument Co.
Millers Falls
Starrett Co.
Thomas Tool
Warren-Knight Co.

**STANDARD CELLS (See Cells, Standard)**

**STANDARD, Acoustic**
Massa Laboratories

**STANDARD, Capacitance**
Aeovox Corp.
Brown Electro-Measurement
Cambridge Inst. Co.
General Radio Co.
Industrial Instruments
Leeds & Northrup Co.
Rubicon Co.
Solar Mfg. Corp.
United Condenser

**STANDARDS, Color**
Fish-Schurmann Co.
Hellige, Inc.
Munsell Color Co.
Tagliabue Div.
Taylor & Co., W. A.

**STANDARDS, E.m.f.**
Cambridge Inst. Co.
Leeds & Northrup Co.
Gray Instrument
Rubicon Co.

**STANDARDS, Frequency**
American Inst. Co.
American Time Prods.
Berkeley Scientific
Browning Laboratories
Crystal Research Labs.
Espey Mfg.
Feiler Engineering
Ferris Inst. Cor.
General Electric Co.
General Radio Co.
Gertsch Products
Hewlett-Packard Co.
MacLeod & Hanopol
Millen Mfg. Co.
Polytechnic Research & Dev.
Potter Instrument
RCA Div.
Riverbank Laboratories
Sherron Metallic
Telechron, Inc.
Times Facsimile Corp.

**STANDARDS, Gamma Roy (See Standards, radioactivity)**

**STANDARDS, Inductance**
Cambridge Inst. Co.
General Radio Co.
Leeds & Northrup Co.
Rubicon Co.

**STANDARDS, Length**
Acme Industrial
Gaertner Scientific
Gurley, W. & L. E.
Sheffield Corp.
Size Control Co.
Swedish Gage Co.
Van Keuren Co.

**STANDARDS, Mass**
Gurley, W. & L. E.
Seedrer-Kohlbusch, Inc.

**STANDARDS, Potential**
Leeds & Northrup Co.
Rubicon Co.
Sensitive Research Inst.

**STANDARDS, Pressure**
Green, Henry J.
Precision Therm.

**STANDARDS, Radioactivity**
Clarkstan Corp.
Kelley-Koett Inst. Div.
Nucleonic Corp.
Tracerlab

**STANDARDS, Resistance**
Associated Research
Beck Bros.
Cambridge Inst. Co.
Cole Instrument
Cutler-Hammer, Inc.
Federal Instrument
General Radio Co.
Gray Instrument
Hardwick, Hindle, Inc.
Industrial Insts. Inc.
Instruments Resistors Co.
International Resistance
Leeds & Northrup Co.
Mepco
Resistance Products Co.
Rubicon Co.
Sensitive Research Inst.
Shallcross Mfg. Co.
Sticht & Co.
Victoreen Instrument Co.
Ward Leonard Elec. Co.
General Radio Co.
Massa Labs.
RCA Div.
Shallcross Mfg. Co.

**STANDARDS, Sound Level**
Audio Tone Oscillator
Massa Laboratories

**STANDARDS Temperature**
Ever Ready Thermometer
Green, Henry J.
Leeds & Northrup Co.
Moeller Instrument Co.
Precision Therm.
Revere Co.
Tagliabue Div.

**STANDARDS, Time**
American Inst Co.
American Time Prods.
General Radio Co.
Potter Instrument
Standard Elec. Time Co.
Stoelting Co., C. H.
Varo Mfg. Co.
Warren Telecron Co.

**STANDARDS, Tuning Fork Frequency**
American Time Products
Marconi Instruments Ltd.
Riverbank Labs.

**STANDARDS, Volume**
Gurley, W. & L. E.
Kontes Glass Co.

**STATION CONTROL EQUIPMENT**
American Meter Co.
Arca Regulators Inc.
Control Corp.
Elec. Indicator Corp.
General Elec. Co.
RCA Manufacturing
Sherron Metallic

**STEAM METERS (See Flow Meters, Steam)**

**STEEL TAPES (See Tapes Steel)**

**STELLAR SPECTROSCOPES (See Spectroscopes, Stellar)**

**STEREOSCOPES**
Abrams Instrument
Fairchild Camera
General Biological
Stratex Instrument Co.

**STEREOSCOPES, X-RAY**
Abrams Instrument
Bausch & Lomb Optical
Fairchild Camera
General Elec. X-Ray Dept.
Kelley-Koett Mfg. Co.
North American Philips
Picker X-Ray
Westinghouse X-Ray Co.

**STETHOSCOPES, ENGINEERS**
Brush Development Co.
Engineers Res. & Dev.
Fairchild Camera
Gilmore, E. R.

**STIFFNESS TESTERS, PAPER (See Tester, Stiffness, Paper)**

**STILLS, AUTOMATIC WATER**
Barnstead Still & Steril
Central Scientific Co.
Electric Hotpack Co.
Fish-Schurman Co.
Goetze Niemer
Precision Scientific
Specialty Glass Co.
Stokes Machine Co.
Weber Bros. Metal Works

**STIRRERS, LABORATORY, Variable Speed**
Aloe Co., A. S.
Western Electric
Central Scientific Co.
Eastern Engg. Co.
Eberbach & Son
Fish-Schurman Corp.
Fisher-Scientific
Humboldt Mfg. Co.
Omega Machine
Palo-Myres, Inc.
Phipps & Bird
Precision Scientific
Technical Products

**STOP WATCHES (See Watches, Stop)**

**STRAIGHT EDGES**
Acme Industrial
American Meas. Inst.
Brown & Sharpe
Dietzen Co.
Keuffel & Esser Co.
Negus, T. S. & J. D.
Scherr Co., George
Speidel & Co.
Swedish Gage Co.
Warren-Knight Co.
Weber Co., F.
White Co., David

**STRAIGHTENING VANES**
Bailey Meter Co.
Builders Providence
Penn Ind. Inst. Corp.
Robinson Orifice Fitting
Simplex Valve & Meter
Taylor Instrument Cos.

**STRAIN GAGES (See Gages, Strain)**

**STRAIN TESTERS, GLASS (See Testers, Strain (Glass)**

**STRAIN-TIME RECORDERS**
Bailey Meter Co.
Baldwin Locomotive
Brush Development
Cambridge Inst. Co.
Consolidated Engineering
Foxboro Co.
Hathaway Instrument
Heiland Research
Keuffel & Esser Co.

**STREAM GAGING INSTRUMENTS**
Foxboro Co.
Gurley, W. & L. E.
Hathaway Instrument
Keuffel & Esser Co.
Leupold & Stevens
Martin-Hubbard Corp.

**STRESS INDICATORS**
Ames Co., B. C.
Bailey Meter Co.
Baldwin Locomotive
Cambridge Inst. Co.
Consolidated Engg.
Dillon & Co.
Emery Co., A. H.
Federal Products Corp.
General Electric Co.
Hathaway Instrument
Magnaflux Corp.
Metron Instrument
Minnesota Electronics
Riehle Div.
Statham Labs.

**STRESS-STRAIN, Indicators**
Ames Co., B. C.
Anderson, Arthur R.
Bailey Meter Co.
Baldwin Locomotive
Brush Development
Chatillon & Sons
Consolidated Engg.
Electronic Products
Emery Co., A. H.
Hathaway Instrument
Magnaflux Corp.
Metron Instruments
Minnesota Electronics
Nosker Eng. Prod.
Sheffield Corp.
Statham Labs.
Swedish Gage Co.
Taller & Cooper
Trimount Inst. Co.

**STRESS-STRAIN, Recorders**
Bailey Meter Co.
Baldwin Locomotive
Brush Development
Cambridge Inst. Co.
Century Geophysical
Consolidated Engg.
Electro Products Labs.
Electronic Products
Emery Co., A. H.
Flader, Inc., Fredric
Hathaway Instrument
Heiland Research
Metron Instruments
Minnesota Electronics
Nosker Eng. Prod.
Olsen Testing Machine
Riechle Div.
Sheffield Corp.
Statham Labs.
Taller & Cooper
Trimount Inst. Co.

**STOBOSCOPES**
Associated Research
Berkshire Laboratories
Biddle Co., Jos. G.
Boulin Inst. Corp.
Commercial Research
Communication Meas. Lab.
Conn, Ltd., C. G.
Electric Eye Equip.
Electronic Engineers
Engineering Res. & Dev.
General Radio Co.
Huggins Labs.
Ideal Laboratory Tool
Sylvania Elec. Prod.
Welch Scientific
Westinghouse Elec.
Zeiss, Inc., Carl

**SULPHUR BOMBS (See Bombs, Sulphur)**

**SULPHUR DIOXIDE, Indicators (See Gas Analyzers, Sulphur Dioxide) Recorders (See Gas Analyzers, Sulphur Dioxide)**

**SUN COMPASS**
Abrams Instrument
Brunson Instrument
Dusenbury Co.
Geophysical Inst. Co.

**SUNSHINE, Indicators & Recorders**
Cambridge Inst. Co.
Friez Instrument
General Elect. Co.
G. M. Mfg. Co., Inc.
Instruments Corp.
Leeds & Northrup Co.
Taylor Inst. Co.
White Co., Inc.

**SUPERVISORY CONTROL EQUIPMENT**
Autocall Co.
Automatic Elec. Chicago
Bristol Co.
Builders Providence
Control Corp.
Cramer & Co., Inc.
General Elec. Co.
Guardian Elec. Mfg. Co.
Leeds & Northrup Co.
Minneapolis-Honeywell
Tagliabue Div.
Westinghouse Elec.

**SURFACE FINISH COMPARATORS (See Comparators, Surface Finish)**

**SURFACE FINISH SPECIMENS**
Acme Industrial
Baird Associates
Blake Co., Edward
Brush Development
General Elec. Co.
Link Eng. & Mfg.
Pipe Machinery
Surface Checking Gage.

**SURFACE FINISH STANDARDS**
Brush Development
Compar Inst. Co.
Pipe Machinery Co.
Surface Checking Gage

**SURFACE FINISH TESTERS**
Baird Associates
Blake Co., Edward
Brush Development Co.
Buehler, Adolph I.
Compar Inst. Co.
Comtor Co.
Federal Products Corp.
General Elec. Co.
Link Eng. & Mfg.
Physicists Research
Sheffield Corp.
Surface Checking Gage
Swedish Gage
Taber Inst. Corp.
Wilder, R. S.
Williams Apparatus

**SURFACE GAGES (See Gages, Surface**

**SURFACE PLATES GLASS**
Bausch & Lomb Optical
Binswanger & Co.
Clark & Sons
DoAll Co.
Fecker, J. W.
Fish-Schurman Co.
Geophysical Inst. Co.
Palos Optical Co.
Zeiss, Inc., Carl

**SURFACE PLATES STONE Crest)**
Herman Stone Co.

**SURGE CREST AMMETERS (Ammeters, Surge-**

**SURGE, Indicators & Recordings**
Cook Electric
Elec. Indicator Corp.
General Electric Co.
Hathaway Instrument
Landis & Gyr.
Sheffield Corp.
Taylor Inst. Cos.

**SURVEY FOOT-ODOMETERS (See Odometers)**

**SURVEYING INSTRUMENTS**
Abrams Instrument
Alpha Instrument Co.
Beckman Co., L.
Berger & Sons
Bliss & Co.
Bray Optical Co.
Bruning Co., Inc.
Brunson Instrument
Dietzgen Co.
Engis Equipment
Ferner Co.
Geier & Bluhm
Goldak Co.
Gurley, W. & L. E.
Hastings Inst. Co.
Kenyon Instrument Co.
Keuffel & Esser Co.
Leupold & Stevens
Lufkin Rule Co.
Pittsburgh Ins. & Mach.
Post Co., Frederic
Republic Lens Co.
Shepard Labs.
Speedometer Electric Co.
Speidel & Co.
Sprengnether Inst.
Starrett Co.
Stratex Instrument Co.
Suverkrop Instruments
Ulmer Co., J. C.
United States Blue Print
Warren Knight Co.
Weber Co.
White Co., Inc.
Zeiss, Inc., Carl.

**SURVEYING INSTRUMENTS, Aneroid**
Am. Paulin System
Dietzen Co.
Heinrich Co., Carl
Wallace & Tiernan
Warren-Knight Co.
White Co.

**SURVEYING INSTRUMENTS, Underground, for wells or bore holes**
Eastman Oil Well
Engineering Labs., Inc.
Engis Equipment
Geophysical Inst. Co.
Halliburton Oil Well
Heiland Research
Sperry-Sun Well Survey
Warren-Knight Co.
White Co.

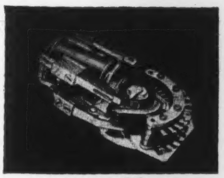
**when you specify stepping switches**

**look for these features**

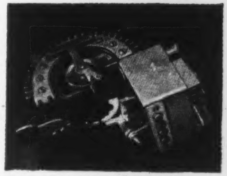
**positive stopping**
Wipers locked at each step without pawl stop blocks; this simplifies adjustment, eliminates maintenance.

**"double twin" wipers**
Bifurcated tips touch both sides of bank contact . . . give twice the dependability of twin contacts.

**operates at −72°C**
Both switches tested to operate efficiently at −72° C . . . especially important in military applications.



type 44



type 45

**find them in Automatic Electric telephone type stepping switches**

Meet a wide range of requirements with the unusual flexibility of these switches. The Type 44 miniature offers capacity, speed, and dependability for complicated space and weight applications. The Type 45 is the only switch of its kind for both d-c and a-c applications. Write for Circular 1698-A. *AUTOMATIC ELECTRIC SALES CORP., 1033 W. Van Buren St., Chicago 7, Ill.* Offices in principal cities.

RELAYS SWITCHES

PRODUCTS OF THE INDUSTRIAL DEPARTMENT OF

AUTOMATIC ELECTRIC

CHICAGO

**BARKSDALE**

sole distributor of

**MELETRON**

PRESSURE ACTUATED SWITCHES

for industrial applications, offers a new pressure switch handbook to industrial users. This new issue was compiled for greater convenience in selecting pressure sensing instruments: it includes a selection table based on functional requirements, and a glossary of terms to aid in specifying equipment.

The book covers the entire industrial pressure switch field: Meletron diaphragm type vacuum and low pressure switches, Meletron Bourdon tube high pressure switches, Barksdale piston type long life switches, and various special function units. Send for your copy.

**BARKSDALE**

1566 EAST SLAUSON AVENUE, LOS ANGELES 11, CALIFORNIA

**SURVEYOR'S CHAINS**
**(See Surveyor's Instruments)**

**SURVEYORS FOOT METERS**
Speedometer Electric Co.

**SWITCHES, Air-operated**
Automatic Temp. Control
Clark Cooper Co.
Cole Instrument
Cook Electric
Cutler-Hammer, Inc.
General Elec. Co.
Johnson Service Co.
Meletron Corp.
Mu-Switch Corp.
Rotron Div.
Shallcross Mfg. Co.
Tagliabue Div.
Westinghouse Elec.

**SWITCHES, Automatic Transfer**
Acro Switch Div.
Allen-Bradley Co.
Allied Control Co.
Anderson, A. & J. M.
Arrow-Hart & Hegeman
Autocall Co.
Automatic Control Co.
Automatic Electric Chicago
Automatic Switcb Co.
Automatic Temp. Control
Barber-Colman
Cook Electric
Cramer & Co., Inc.
Cutler-Hammer, Inc.
**Federal Telephone Co.**
General Elec. Co.
Hart Mfg. Co.
Haydon Co., A. W.
H-B Instrument
Lumenite Electronic
Ward Leonard Elec. Co.
Westinghouse Elec.

**SWITCHES, Counter-actuating**
Electro-Tech Equipment
Hetherington, Inc.
Jo-Bell Products
Micro Switch
Photoswitch Inc.

**SWITCHES, Instrument**
Acro Switch Div.
Allen-Bradley Co.
Allis-Chalmers
Arrow-Hart & Hegeman
Autocall Co.
Automatic Electric Chicago
Automatic Temp. Control
Barber-Colman
Betts & Betts
Brown Electro-Measurement
Carter Parts Co.
Centralab Div.
Cinema Engr.
Cole Instrument
Cook Electric
Cutler-Hammer, Inc.
Daven Co.
Dittmore & Freimuth
Federal Anti-Capacity
General Cement Mfg.
General Elec. Co.
General Radio Co.
Hart Mfg. Co.
Industrial Insts., Inc.
J-B-L Inst. Co.
J-B-T Instruments
Kellogg Switchboard
Lewis Engg.
Mallory & Co.
McDonnell & Miller
Mercoid Corp.
Micro Switch Div.
Mossman, Inc.
Oak Mfg. Co.
Ohmite Mfg. Co.
Roller-Smith
Rubicon Co.
Sensitive Research Co.
Shallcross Mfg.
Teleoptic Co.
Thwing-Albert Instrument
Trimount Inst. Co.
Triplett Elec. Inst. Co.
United States Inst. Corp.
Westinghouse Elec.
Weston Elec. Inst. Corp.
Wheelco Instrument
Winston Co.

**SWITCHES, Magnetic**
Allen Bradley Co.
Allis-Chalmers
Arrow-Hart & Hegeman
Autocall Co.
Automatic Switch Co.
Automatic Temp. Control
Clark Cooper Co.
Cook Electric
Cutler-Hammer, Inc.
General Cement Mfg.
General Elec. Co.
Jo-Bell Products
Neomatic Inc.
Soreng Mfg. Co.
Ward Leonard Elec. Co.

**SWITCHES, Mercury**
Arrow-Hart & Hegeman
Climax Div.
Continental Elec. Co.
Cutler Hammer, Inc.
Durakool, Inc.
Electronic Apparatus
Electro-Tech Equipment
Fredericks, George
General Cement Mfg.
General Elec. Co.
H-B Instrument
Kahl Scientific Inst.
Magnetrol Inc.
McAlear Mfg. Div.
Mercoid Corp.
Minneapolis-Honeywell
Rhodes, Inc.

**SWITCHES, Pyrometer**
Acro Switch Div.
Arrow-Hart & Hegeman
Bristol Co.
Brown Inst. Div.
Cole Instrument
Daven Co.
Engelhard, Chas.
Foxboro Co.
General Cement Mfg.
General Elec. Co.
J-B-L Instrument
Leeds & Northrup Co.
Lewis Engg Co.
Revere Corp.
Rowe Engineering
Tagliabue Div.
Thwing-Albert Inst. Co.
Triplett Elec. Inst.
United States Inst. Corp.
Westinghouse Elec.
Weston Elec. Inst. Corp.
Wheelco Instruments
Winslow Co.

**SWITCHES, Relay**
Acro Switch Div.
Allen-Bradley Co.
American Relay & Controls
Arrow-Hart & Hegeman
Autocall Co.
**Automatic Elec. Chicago**
Automatic Switch Co.
Automatic Temp. Control
Betts & Betts
Clark & Co.
Cook Electric Co.
Cutler-Hammer, Inc.
Federal Telephone
Friez Instruments Div.
General Cement Mfg.
General Controls Co.
General Elec. Co.
Guardian Elec. Mfg. Co.
Hart Mfg Co.
H-B Instrument
Kellogg Switchboard
Mallory & Co.
Micro Switch Div.
Neomatic Inc.
Perfex Corp.
Photoswitch, Inc.
Roller-Smith
Skaneateles Mfg. Co.
Struthers-Dunn
Ward Leonard Elec. Co.
Warrick Co.
Westinghouse Elec.

**SWITCHES, Rotary**
Allen-Bradley Co.
Applied Science Corp.
Arrow-Hart & Hegeman
Autocall Co.
Automatic Elec. Chicago
Barber-Coleman
Bird Electronic
Brown Electro-Measurement
Carter Parts Co.
Centralab Div.
Clarostat Mfg. Co.
Cole Instrument
Cutler-Hammer, Inc.
Daven Co.
Dittmore & Freimuth
Eastern Specialty
Federal Telephone
Foxboro Company
General Cement Mfg.
General Control Co.
General Elec Co.
General Radio Co.
Guardian Elec. Mfg. Co.
H-B Instrument
Hetherington & Son
J-B-L- Instrument
J-B-T- Instruments
Leeds & Northrup Co.
Lewis Engg. Co.
Mallory & Co.
Micro Switch Div.
Neomatic Inc.
Oak Mfg. Co.
Ohmite Mfg. Co.
Roller-Smith
Rubicon Co.
Sensitive Research Inst.
Shallcross Mfg. Co.
Tagliabue Div.
Thwing-Albert Inst. Co.
Triplett Electrical Inst.
United States Inst. Corp.
Utah Radio Prods.
Westinghouse Elec.
Weston Elec. Inst. Corp.

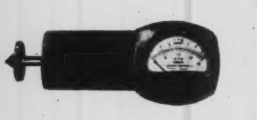
**SWITCHES, Selector**
Acro Switch Div.
Allen-Bradley Co.
Allis-Chalmers
Arrow-Hart & Hegeman
Automatic Elec. Chicago
Betts & Betts
Bird Electronic
Carter Radio Co.
Centralab Div.
Cinema Engr.
Cole Instrument
Cook Electric
Cutler-Hammer. Inc.
Daven Co.
Federal Telephone
General Cement Mfg.
General Elec. Co.
Guardian Electric
H-B Instrument Co.
J-B-L- Instrument
Leeds & Northrup Co.
Lewis Engineering
Mallory & Co.
Meter Devices Co.
Mossman, Inc.
Oak Mfg. Co.
Ohmite Mfg. Co.
Revere Co.
Shallcross Mfg. Co.
Soreng Mfg. Co.
Thwing-Albert Inst. Co.
United States Inst. Corp.
Vectron, Inc.
Ward Leonard
Westinghouse Elec.
Wheelco Instrument

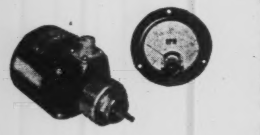
**SWITCHES, Snap**
Acro Switch Co.
Arrow-Hart & Hegeman
Automatic Temp. Control
Betts & Betts
Cherry-Channer Corp.
Clark Cooper Co.
Cutler-Hammer, Inc.
General Cement Mfg.
General Controls
General Elec. Co.
Guardian Electric
Hetherington & Son
J-B-L Instrument
Jo-Bell Products
Leeds & Northrup
Mallory & Co.
McAlear Mfg. Div.
Micro Switch Div.
Minneapolis-Honeywell
Mu-Switch Corp.
Perfex Corp.
Soreng Mfg. Co.
Ulanet Co., Geo.
Unimax Switch Corp.
Ward Leonard Elec. Co.
Westinghouse

**SWITCHES, Thermostatic**
Acro Switch Div.
Airite Prod. Co.
Advance Electric Co.
Allen-Bradley Co.
Barber-Colman
Betts & Betts
Bridgeport Thermo Co.
Burling Instrument Co.
Clark Cooper Co.
Control Products, Inc.
Cook Electric Co.
Dickson Co.
Fenwal, Inc.
Friez Instruments
General Cement Mfg.
General Controls
General Elec. Co.
Gleason-Avery, Inc.
Guardian Electric
G-V Controls
Hart Mfg. Co.
Hawk Tool Eng. Co.
Mercoid Corp.
Micro Switch Div.
Minneapolis-Honeywell
Mu-Switch Corp.
Perfex Corp.
Powers Regulator
Shallcross Mfg. Co.
Smith Control & Insts.
Spencer-Thermostat Co.
Struthers-Dunn
Tagliabue Div.
Thwing-Albert Inst.
Ulanet Co., George
Unimax Switch Corp.
United Electronic Controls
Viking Instruments
Ward Leonard Electric Co.

**SWITCHES, Time**
Acro Switch Div.
Alina Corp.
Allen-Bradley Co.
Anderson, A. & J. M.
Autocall Co.
Automatic Elec. Mfg.
Automatic Temp. Control
Barber-Colman
Betts & Betts
Cincinnati Time Rec.
Cramer Co., Inc.
Cutler-Hammer, Inc.
Dimo-Gray Co.
Dorothea Mechanisms, Gale
Eagle Signal Corp.
Edison Instrument Div.
Electro-Tech. Equip.
Electyme Motor Prods.
General Cement Mfg.
General Controls
General Elec. Co.
Guardian Elec. Mfg. Co.
G-V Controls
Haydon Co., A. W.
Haydon Mfg. Co.
Industrial Timer
International Register Co.
Landis & Gyr, Inc.
Leich Elec. Co.
Lumenite Electronic
Lux Clock Mfg. Co.
Mallory & Co.
Mercoid Corp.
Minneapolis-Honeywell
Montgomery Mfg. Co.
Neomatic Inc.
Paragon Electric Co.
Perfex Corp.
Photoswitch, Inc.
Photovolt Corp.
Precision Products, Inc.
Richardson-Allen
Rhodes, Inc., M. H.

(Continued)





E L E C T R I C
TACHOMETERS
*Simplified RUGGED Design*

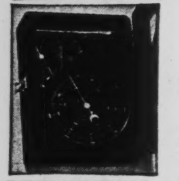
HAND MODEL
Small size and light weight—ideal for any shop and production test application. Precision made, sealed ball bearings, and the elimination of wearing parts assure constant accuracy. Models from 0 –2,400 RPM + 800 FPM, 5,000, 15,000 and 25,000 RPM.

PORTABLE MODEL
Measures any rotating speed with sustained accuracy for production and laboratory use. Three-range expanded scale: 0 to 1000, 1000 to 2500, 2500 to 5000 and other models up to 20000 RPM. Stability assured with no contacts, brushes or batteries to wear out. Accuracy ½, 1, or 2% of full scale.

MOUNTED MODEL
Indicating Non-directional, forward or reverse speeds in any required range up to 25000 RPM. Available with SAE fittings and base mount. Calibrated to your exact needs. Completely enclosed and protected against moisture and dirt.

Special models made for any specific requirements.

THE ELECTRO-MECHANO CO.
261 Erie St., Milwaukee, Wis.



TACHOMETERS

TYPE "U"
UNIVERSAL CENTRIFUGAL TYPE
5 Ranges in 1 Instrument
Cat. No. 303 30-12,000 RPM
Cat. No. 314 45-18,000 RPM
Cat. No. 322 60-24,000 RPM
Cat. No. 346 120-48,000 RPM
*Bulletin 750-N*

MODEL "J"
TRIPLE RANGE CENTRIFUGAL
Cat. No. 312 300-12,000 RPM
Cat. No. 1412 100-12,000 RPM
SINGLE RANGES
100-1200 RPM, 200-2400 RPM
300-3600 RPM, 400-4800 RPM
*Bulletins 760-N, 790-N*

"JAQUET"
SPEED INDICATORS (CHRONOMETRIC)
Guaranteed Accuracy within ½ of 1%
Cat. No. 2301 0-10,000 RPM
Cat. No. 2302 0- 1,000 RPM
Suitable double rated speed. 3 models, various accessories.
*Bulletin 735-N*

STATIONARY TYPE
MODEL "J"
Sizes, 3", 4", 5½", 8", 10", and 20" dial diameter, flexible shaft driven.
Many standard ranges reading RPM, FPM, YPM, etc.
*Bulletins 795-N, 796-N 797-N*

HERMAN H. STICHT CO., INC.
27 PARK PLACE NEW YORK, N.Y.

Sampsel Time Control
Sangamo Electric Co.
States Co.
Stoelting Co., C. H.
Stromberg Time Corp.
Telechron, Inc.
Thomas Clock Co., Seth
Thompson Clock Co.
Tork Clock
Ulanet Co., Geo.
Walker-Jamieson, Inc.
Walser Automatic Timer
Ward Leonard Elec. Co.
Westinghouse Elec.
Yellow Springs Inst.

**SYNCHRONIZATION FORKS, Electrical (See Forks, Synchronization)**

**SYNCHRONOUS MOTORS (See Motors, Synchronous)**

**SYNCHROSCOPES**
Control Corp.
Eclipse Aviation
Electric Controller
Feiler Engineering
General Elec. Co.
Hickok Elec. Inst. Co.
Kollsman Inst. Co.
Millen Mfg. Co.
Roller-Smith Co.
Triplett Elec. Co.
Westinghouse Elec.
Weston Elec. Inst. Corp.

**TACHOGRAPHS**
Amthor Testing Inst.
Biddle Co., Jas. G.
Cole Instrument
Cramer & Co., Inc.
Metron Instrument
Sticht Co.
Zeiss, Inc., Carl
Zernickow Co., O.

**TACHOMETER TESTERS (See Testers, Tachometer)**

**TACHOMETERS, Centrifugal**
Aeromarine Inst. Co.
Amthor Testing Inst. Co.
Associated Research
Barbour Stockwell Co.
Biddle Co., Jas. G.
Boulin Instrument Corp.
Corbin Screw Corp.
Durant Mfg. Co.
Eclipse-Pioneer Div.
Elec. Tachometer Corp.
Foxboro Co.
General Elec. Co.
Hays Corp.
Jones Motrola Sales
Kollsman Instrument
Manning, Maxwell & Moore

(Continued)

Pioneer Instrument Co.
Scherr Co., Inc.
Seedburo Equipment
Stewart-Warner Corp.
Sticht Co.
Veeder-Root, Inc.
Viking Instrument Co.
Zernickow Co., O.

**TACHOMETERS, Chronometric**
Amthor Testing Inst.
Associated Research
Berkeley Scientific
Biddle Co., Jas. G.
Boulin Inst. Corp.
Cramer & Co., Inc.
Elec. Tachometer Corp.
Elgin Nat'l. Watch Co.
Hasler-Tel Co.
Jaeger Watch Co.
Milwaukee Prec. Instr.
Pierce Watch Co.
Potter Instrument
Scherr Co., Inc.
Standard Elec. Time
Sticht Co.
Zernickow Co., O.

**TACHOMETERS, Cross-pendulum**
Amthor Testing Inst.
Associated Research
Biddle Co., Jas. G.
Manning, Maxwell & Moore
Sticht Co.
Zernickow Co., O.

**TACHOMETERS, Electric**
Bailey Meter Co.
Bristol Co.
Brown Inst. Div.
Chicago Elec. Tachometer
Clarke Inst. Corp.
Cole Instrument
Crown Ind. Prods.
Eclipse-Pioneer Div.
Electric Speed Ind. Co.
Elec. Tachometer Corp.
Electro Mechano Co.
Engineering Research & Dev.
Esterline-Angus Co.
Foxboro Co.
General Elec. Co.
Hastings Inst. Co.
Hathaway Inst. Co.
Hays Corp.
Hickok Elec. Inst. Co.
Ideal Industries, Inc.
Instrument Lab. Inc.
Jaeger Watch Co.
J-B-T Instruments
Jones Motorola Sales
Kay Electric
Kollsman Instrument
Martin Decker Corp.
Metron Instruments
Minnesota Electronics
Moisture Register Co.
Nat'l. Instrument Co.
Photocon Research
Pitometer Log Corp.
Potter Instrument
Scherr Co. Inc.
Standard Elec. Time
Sticht Co.
Sun Electric Corp.
Westberg Mfg. Co.
Westinghouse Elec.
Weston Elec. Inst. Corp.
Winslow Co.
Yellow Springs Inst. Co.

**TACHOMETERS, Electromagnetic**
Eclipse-Pioneer Div.
Electric Auto-Lite
Electric Tachometers
Electro Mechano Co.
General Electric Co.
Ideal Industries
Jaeger Watch Co.
Kollsman Inst. Co.
Nat'l. Instrument Co.
Potter Instrument
Standard Elec. Time Co.
Sun Electric
Stewart-Warner Corp.
Triplett Elec. Inst.
Waltham Watch
Westberg Mfg. Co.
Westinghouse Elec.

**TACHOMETERS, Fly-ball**
Aeromarine Inst. Co.
Barbour Stockell Co.
Biddle Co., Jas. G.
Boulin Instrument Corp.
Elec. Tachometer Corp.
Jones Motrola Corp.
Manning, Maxwell & Moore
Sticht Co.
Viking Instrument Co.

**TACHOMETERS, Ignition Actuated**
Electro-Tech Equipment
Engineering Res. & Dev.
Potter Instrument
Stewart-Warner

**TACHOMETERS, Portable**
Amthor Testing Inst. Co.
Associated Research
Barbour Stockwell Co.
Biddle Co., Jas. G.
Boulin Instrument Corp.
Chicago Elec. Tachometer
Corbin Screw Corp.
Electro Mechano Co.
Elec. Tachometer Corp.
Foxboro Co.
General Elec. Co.
Hasler-Tel Co.
Ideal Industries
Jones Motrola Corp.
Manning, Maxwell & Moore
Rieker Instrument Co.
Scherr Co., Inc.
Stewart-Warner
Sticht Co.

(Continued)

Sun Electric Corp.
Viking Instrument Co.
Westberg Mfg. Co.
Winslow Co.
Zernikow Co.

**TACHOMETERS, Recording**
Bailey Meter
Bristol Co.
Engineering Res. & Dev.
Esterline-Angus
Potter Instrument

**TACHOMETERS, Speed Limit Control**
Askania Regulator Co.
Barbour Stockwell Co.
Bristol Co.
Flight Research Eng.
General Elec. Co.
Jones Motrola Corp.
Metron Instrument
Sticht Co.
Standard Elec. Time
U. S. Taximeter
Westberg Mfg. Co.
Zernikow Co.

**TACHOMETERS, Stroboscopic**
Associated Research
Berkshire Laboratories
Boulin Instrument Corp.
Clarke Inst. Corp.
General Radio Co.
Ideal Laboratory Tool
L. A. B. Corp.

**TACHOMETERS, Tilting-ring**
Amthor Testing Inst. Co.
Westberg Mfg. Co.
Zernikow Co.

**TACHOMETERS, Vibrating Reed**
Biddle Co., Jas. G.
J-B-T Instruments

**TACHOSCOPES**
Amthor Testing Inst. Co.
Biddle Co., Jas. G.
Scherr Co., Inc.
Sticht Co.
Zernickow Co., O.

**TAFFRAIL LOGS; SHIP**
Bliss & Co.
Hand & Sons
Westberg Mfg. Co.

**TANGENT METERS (See Meters, Tangent)**

**TAPES, Oil Gauger's**
Dietzgen Co.
Keuffel & Esser Co.
Lufkin Rule
Starrett Co.
White Co., David

**TAPES, Steel**
Bruning Co., Inc.
Dietzgen Co.
Kueffel & Esser Co.
Lufkin Rule Co.
Speidel & Co.
Starrett Co.
United States Blue Print
Warren-Knight Co.
Weber Co.
White Co., David

**TAPES, Surveyor's (See Surveying Instruments)**

**TAPES, Woven**
Lufkin Rule Co.
White Co., David

**TAXI METERS**
U. S. Taximeter

**TELEMETERING SYSTEMS (See Remote Metering)**

**TELEMETERS (Surveying & Military—Optical)**
Applied Science Corp.
Kollmorgen Optical Co.
Keuffel & Esser Co.
Pacific Div.
Pierce Watch Co.

**TELESCOPES, Alignment**
Acme Industrial
Bray Optical Co.
Dome Precision
Engis Equipment
Fecker, Inc.
Gaertner Scientific
**General Engg. & Model**
Howland Optical Co.
Keuffel & Esser Co.
Kollmorgen Optical Co.
Optical Ser. & Dev.
Palos Optical Co.
Perkin-Elmer Corp.
Plummer & Kershaw
Scherr Co., Inc.
Stratex Instrument Co.
Tinsley Laboratories
Unertl Optical Co.
White Co., Inc.

**TELESCOPES, Astronimical**
Bausch & Lomb Opt.
Buchele, W.
Clark & Sons
Davidson Mfg. Co.
Dome Precision
Eastern Science Co.
Fecker, Inc.
Gaertner Scientific Corp.
Henson Co., Fred C.
Ice Optical Co., H. C.
Mann Co., W. I.
Mico Instrument Co.
Palos Optical Co.
Perkin-Elmer Corp.
Plummer & Kershaw
Tinsley Labs.
Unertl Optical Co.
White Co.
Zeiss, Inc., Carl

**TELESCOPES, Azimuth**
American Optical
Clark & Sons
Fecker, Inc.
Gaertner Scientific Corp.
Kollmorgen Optical Co.
Palos Optical Co.
Perkin-Elmer Corp.
Plummer & Kershaw
Tinsley Labs.
Unertl Optical Co.
Warren-Knight Co.
Warner & Swasey Co.
White Co.
Zeiss, Inc., Carl

**TELESCOPES, Bore & Internal Surface, Inspection**
American Cystoscope
American Optical
Ames Co., B. C.
Fecker, J. W.
Gaertner Scientific
Kollmorgen Optical Co.
Leitz, Inc.
Lenox Inst. Co.
Magnaflux Corp.
Perkin-Elmer Corp,
Plummer & Kershaw
Scherr Co., Inc.
Schneider-Cogswell
Swedish Gage Co.
Unertl Optical Co.
Zeiss, Inc., Carl

**TELESCOPES, Laboratory**
American Optical
Bausch & Lomb
Central Scientific
Eberbach & Son
Fecker, Inc.
Gaertner Scientific Corp.
Henson Co., Fred C.
Optical Ser. & Dev.
Palos Optical Co.
Plummer & Kershaw
Precise Measurements Corp.
Ruska & Co.
Tinsley Laboratories
Unertl Optical Co.

**TELESCOPES, Reflecting**
Buchele, W.
Clark Sons
Fecker, Inc.
Fish-Schurman Co.
Gaertner Scientific
Henson Co., Fred C.
Howland Optical Co.
Ice Optical Co., H. C.
Palos Optical Co.
Perkin-Elmer Corp.
Plummer & Kershaw
Tinsley Labs.
Unertl Optical Co.
Warner & Swasey Co.
Zeiss, Inc., Carl

**TELESCOPES, Refracting**
Buchele, W.
Bausch & Lomb Opt.
Clark & Sons
Davidson Mfg. Co.
Fish-Schurman Co.
Fecker, Inc.
Gaertner Scientific
Henson Co., Fred C.
Howland Optical Co.
Ice Optical Co., H. C.
**Keuffel & Esser Co.**
Palos Optical Co.
Perkin-Elmer Corp.
Plummer & Kershaw
Tinsley Labs.
Unertl Optical Co.
Warner & Swasey Co.
Wollensak Optical Co.
Zeiss, Inc., Carl

**TELESCOPES, Zenith**
Clark & Sons
Fecker, Inc.
Gaertner Scientific Corp.
Ice Optical Co., H. C.
Perkin-Elmer Corp.
Plummer & Kershaw
Tinsley Labs.
Unertl Optical Co.
White Co., David
Zeiss, Inc., Carl

**TELEVISION, Industrial**
Diamond Power Specialty
Dumont
General Electric
RCA

**TENSIOMETERS**
Baldwin Locomotive
Boulin Instrument Corp.
Central Scientific Co.
Chatillon & Sons
Dillon Co.
Federal Products Corp.
General Electric Co.
Geophysical Inst. Co.
Metron Instrument
Millers Falls
Olsen Testing Machine
Pacific Scientific
Rutishauser Corp.
Saxl Instrument
Schaevitz Engineering
Statham Labs.
Suter, Alfred
Thwing-Albert
Toledo Scale Co.

**TENSION INDICATORS**
Baldwin Locomotive
Boulin Instrument
Chatillon & Sons
Cole Instrument
Dillon Co.
**Emery Co., A. H.**
Federal Products Corp.
General Electric Co.
Geophysical Inst. Co.
Olsen Testing Mach.
Pacific Scientific Co.
Precision Scientific
Saxl Instrument
Seederer-Kohlbusch, Inc.
Wiancko Engineering

Specialized Test Equipment for

Diesel and fuel-injection engine components and auxiliaries ........................................

•

Universal pump and governor test-stand for all types of high- and low-pressure calibration.

•

Test-stand for single-unit pumps for heavy Diesel both ship and railroad calibrating. (Spec. furnished on both stands on request)

•

Uni-directional unit for counters and tachometers.

•

Spray-nozzle patterns test-stand with Stroboscopic unit.

•

Self-contained fog dispenser unit for nozzle testing.

•

Hydraulic swedger for high-pressure tubing. Also bearing remover.

•

Compact automotive coil condenser and generator tester.

•

FERRIER ENGINEERING
24 Benton St., Springfield, Mass.

**TENSION INDICATORS Textile**
Boulin Instrument Corp.
Chatillon & Sons
Dillon & Co.
Federal Products Corp.
General Elec. Co.
Olsen Testing Mach.
Pacific Scientific Co.
Saxl Instrument
Statham Labs.

**TEST BLOCKS**
Brown & Sharpe
Clarke Instrument
Detroit Testing Mach.
Eastern Specialty Co.
Fonda Gage Co.
General Elec. Co.
Kent Cliff Labs.
Olsen Testing Mach.
States Co.
Steel City Testing Mach.
Van Keuren Co.

**TEST BLOCKS (Textile)**
Boulin Instrument Corp.

**TEST INDICATOR**
Ames Co., B. C.
Brown & Sharpe
Deming Indicator Co.
Federal Products Corp.
Gadgets Inc.
Lewis Engineering
Scherr Co., Inc.
Starrett Co.

**TEST STANDS, Propeller**
Airplane Mfg. & Supply
Falstrom Co.
Gadgets Inc.

**TEST WEIGHTS (See Weights, Test)**

**TEST WELLS (See Thermometer Test Wells)**

**TESTERS, Abrasion**
American Inst. Co.
Amthor Testing Inst. Co.
Atlas Elec. Devices Co.
Baldwin Locomotive
Fidelity Mach. Co.
Gardner Laboratory
General Elec. Co.
Morehouse Machine Co.
Olsen Testing Machine
Riehle Div.
Scott Testers, Inc.
Shawmut Engr. Co.
Suter, Alfred
Taber Instrument Co.
Testing Machines, Inc.
Zuhr, Inc., Henry

**TESTERS, Absorption**
Burrell Tech. Supply
Gurley, W. & L. E.
Humboldt Mfg. Co.

(Continued)

Nankervis Co., G. L.
Precision Scientific
Testing Machines, Inc.
Willams Apparatus

**TESTERS, Air Speed Indicator (See Air Speed Indicator Testers)**

**TESTERS, Altimeter (See Altimeter Testers)**

**TESTERS, Armature**
Associated Research, Inc.
Communication Meas. Lab.
Instrument Labs.
Schauer Mfg. Co.
Sherron Metallic

**TESTERS, Asphalt**
American Inst. Co.
Atlas Eectric Devices
Bowen & Co.
Braun Corp.
Central Scientific Co.
Chatillon & Sons
Dillon & Co.
Exact Weight Scale
Fish-Schurman Co.
Fisher Scientific Co.
Humboldt Mfg. Co.
Koehler Instrument
Olsen Testing Mach.
Philadelphia Thermometer
Precision Scientific Co.
Riehle Test. Mach. Div.
Scott Testers, Inc.
Tagliabue Div.
Thwing-Albert Inst.

**TESTERS, Axle**
Olsen Testing Mach.
Riehle Test. Mach. Co.
Sperry Products, Inc.

**TESTERS, Battery**
Clough-Brengle Co.
Daven Co.
Edelman & Co.
Electro-Mech. Inst.
Electronic Development
Electronic Instrument
Freas Glass Works
General Electric Co.
Hickok Elec. Inst. Co.
Instrument Labs.
Kimble Glass
Precision Therm.
Rascher & Betzold
Rieker Inst. Co.
Simpson Electric
Sterling Mfg. Co.
Testrite Inst. Co.
Triplett Elec. Inst.
Weston Elec. Inst. Corp.

**TESTERS, Bearing**
Elgin National Watch
Engineering Res. & Dev.
Physicists Research

**TESTERS, Beating**
Precision Scientific
Testing Machines, Inc.
Williams Apparatus Co.

**TESTERS, Brake**
American Inst. Co.
Clough-Brengle Co.
Commercial Research
Cramer & Co., Inc.
Emery Co., A. H.

**TESTERS, Camera Shutter**
Triumph Mfg. Co.

**TESTERS, Chlorine**
Everson Mfg. Co.
Hellige, Inc.
Industrial Inst., Inst.
LaMotte Chemical Prods.
Photovolt Corp.
Precision Scientific
Rascher & Betzold
Taylor & Co., W. A.
Wallace & Tiernan

**TESTERS, Coal (See Fuel below)**

**TESTERS, Coil (Electric)**
Associated Research
Boonton Radio Corp.
Clippard Inst. Lab.
Clough-Brengle Co.
Cole Instruments
Feiler Engineering
General Elec. Co.
General Radio
Ideal Industries
Industrial Insts., Inc.
Instrument Labs.
Kellogg Switchboard
Panoramic Radio Co.
Radex Corp.
Rubicon Co.
Schauer Mfg. Co.
Sherron Metallic
Technology Instrument
Thordarson Elec. Mfg.
United Transformer

**TESTERS, Color**
Atlas Electric Devices Co.
Fisher Scientific Co.
Gaertner Scientific Corp.
Gardner Laboratory
General Elec. Co.
Hellige, Inc.
Huggins Labs.
Instrument Dev. Labs.
Photovolt Corp.
Tagliabue Div.

**TESTERS, Condenser**
Aerovox Corp.
Associated Research
Boonton Radio Corp.
Bradshaw Instruments
Clippard Inst. Lab.
Clough-Brengle Co.
Cornell Dublier
Electronic Development
Electronic Instrument
Feiler Engineering
Fox Valley Inst.
General Electric Co.
General Radio Co.
Hickok Elec. Instrument
Industrial Insts. Inc.
Instrument Labs.
Jackson Electrical Inst.
Kalbfell Labs., Inc.
Kellogg Switchboard
Potter Co.
Radio City Products
Reiner Electronics
Rubicon Co.
Schauer Mfg. Co.
Sherron Metallic
Tobe Deutschmann Corp.
Triplett Electrical Inst.
Weston Elec. Inst. Corp.
Williams Apparatus

**TESTERS, Deflection, Light Wave**
Acme Industrial
Bowser, Inc.
Gaertner Scientific Corp.
Sherron Metallic
Van Keuren Co.

**TESTERS, Dew Point**
Bowser, Inc.
Ferner Co.
General Electric
Instrument Dev. Labs.
Refinery Supply Co.
Tagliabue Div.

**TESTERS, Dielectric, Properties**
American Transformer Co.
Antenna Research Lab.
Associated Research, Inc.
Boonton Radio Corp.
Cole Instrument
Electronic Dev. Lab.
General Elec. Co.
General Radio
Instrument Labs.
Leeds & Northrup Co.
Miller Co., B. F.
Roller-Smith
Sherron Metallic
Tagliabue Div.
Westinghouse Elec.
Winslow Co.

**TESTERS, Electroplating (See Electroplating Solution Testing Apparatus)**

**TESTERS, Emulsion & Demulsibility**
Central Scientific Co.
Precision Scientific

**TESTERS, Expansion**
Dietert Co.
Dillon & Co.
Exact Weight Scale Co.
Ferner Co.
Humboldt Mfg. Co.
Gaertner Scientific Corp.
Thwing-Albert Inst. Co.

**TESTERS, Fading**
Atlas Elec. Devices Co.
Gen. Elec. Vapor Lamp

**TESTERS, Flash Point, Abel-Pensky's (See Abel's above)**

**TESTERS, Flash Point, Clevelad Open Cup**
American Inst. Co.
Boekel & Co.
Central Scientific Co.
Humboldt Mfg. Co.
Koehler Instrument
Olsen Testing Machine
Precision Scientific Co.
Ruehfel Co.
Tagliabue Div.

**TESTERS, Flash Point, Elliott Closed Cup**
American Inst. Co.
Central Scientific Co.
Humboldt Mfg. Co.
Precision Scientific Co.
Ruehfel Co.
Tagliabue Div.

**TESTERS, Flash Point, Pensky-Martens**
American Inst. Co.
Boekel & Co.
Central Scientific Co.
Humboldt Mfg. Co.
Koehler Instrument
Precision Scientific Co.
Ruehfel Co.
Tagliabue Div.

**TESTERS, Flash Point, Tag Closed**
Central Scientific Co.
Humboldt Mfg. Co.
Koehler Instrument
Precision Scientific Co.
Ruehfel Co.
Tagliabue Div.

**TESTERS, Flatness, Light Wave**
Acme Scientific
Baird Associates
Bausch & Lomb
Crystal Research Labs.
Fecker, J. W.
Fish-Schurman Co.
Gaertner Scientific Co.
Geophysical Inst. Co.
Howland Optical
Optron Laboratory
Scherr Co., Inc.
Sherron Metallic
Van Keuren Co.
Zeiss, Inc., Carl

OUTSTANDING

VIBROTEST . . . PUSH-BUTTON INSULATION RESISTANCE TESTING

Vibrotest is the fast, accurate way to measure all insulation resistances to 50,000 megohms . . . NO CRANKING OR LEVELING . . . All electric . . . Fully portable . . . Rugged. Only two binding posts for all tests. Several models have A.C. and D.C. volt ranges, as well as low resistance ohmmeter.
Make your insulation resistance testing a "push-button" operation with Vibrotest. Write for Bulletin 2A.

HYPOT . . . HIGH-POTENTIAL INSULATION RESISTANCE TESTING

Hypot Models from small, fully-portable instruments to high-capacity, high-voltage wheeled units. Ranges from 0-1500 V.A.C. at 80 VA. capacity to 0-50,000 V.A.C. at 5 K.W. capacity. Hypot Juniors have separate visual indications for leakage, breakdown or shorts. All models fast and simple to operate; ruggedly built for long, low-cost use. Write for Bulletins 4A and 5A.

VIBROGROUND . . . GROUND RESISTANCE TESTING

Direct readings of true resistance to earth of man-made grounds, soil and earth resistivity with Vibroground testing. No leveling, cranking or outside power source necessary. Light weight, rugged for hardest field service. Models to suit every need. Write for Bulletin 105.

OTHER ARI Precision Instruments include tachometers, limits bridges, phase sequence indicators, volt-ammeters, ohmmeters, current transformers, Keeler Polygraph (Lie Detector), and special instrumentation of many types. Write for details.

ASSOCIATED RESEARCH, Incorporated
"Precision Instruments Since 1936"
3762 West Belmont Avenue, Chicago 18, Illinois

"MEGOHMER" INSULATION TESTERS

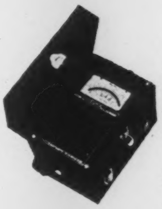
GENERATOR TYPES

MINOR
Dwarf size, 0-10 or 0-20 or 0-50 megohms, variable pressure, 500 Volts D.C. Bulletin 450.

MAJOR
0-50 megohms with extra ohm scale, 0-30 or 0-10,000 ohms, constant pressure, 500 Volts D.C. Bulletin 465.

STANDARD
Heavy duty type, 500 or 1000 Volts D.C., constant pressure. Ranges up to 2000 megohms. Double and triple range. Bulletin 455.

BATTERY VIBRATOR TYPES



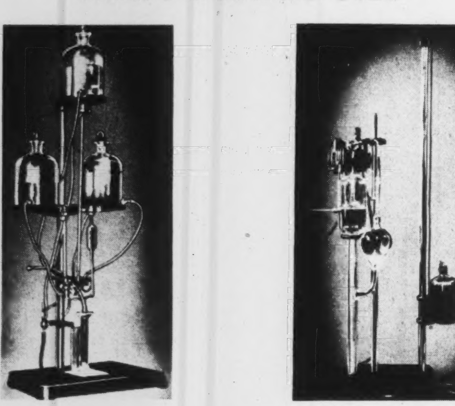
MODEL B-7
Four ranges in one instrument: 0-20/200 megohms, 0-200/20,000 ohms. Two test potentials: 250 and 500 Volts D.C. Bulletin 440.

MODEL B-6
Four instruments in one. Six ranges: 0-200 megohms, 0-2000 ohms, 0-150/600 Volts A.C., 0-150/300 Volts D.C. Bulletin 441.

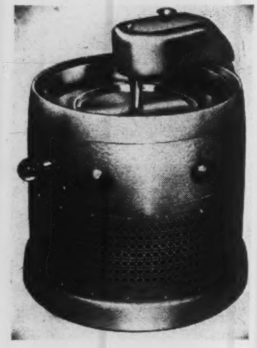
HERMAN H. STICHT CO., INC.
27 PARK PLACE NEW YORK 7, N. Y.

# Testing and Control Instruments and Equipment

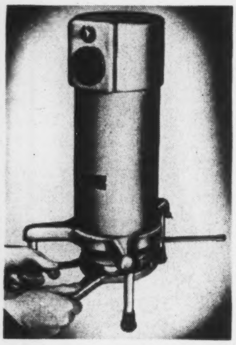
## for Moisture, Carbon, Sulfur, Sand, Micro-Particle Size



**Two-Minute Carbon and Sulfur Determinators For Metals and Organic Materials**



**Micro-Particle Classifier for Classification of Fine Materials.**



**Moisture Teller for Quickly and Accurately Determining the Moisture Content of all types of Material.**

## Harry W. Dietert Co.

**9330 Roselawn Avenue** **Detroit 4, Michigan**

**TESTERS, Fluorescent Lighting**
Eitzen Company
Littelfuse, Inc.
Skaneateles Mfg.
Sylvania Elec. Prod.

**TESTERS, Freeness**
Bristol Co.
Dietert Co.
Testing Machines, Inc.
Williams Apparatus Co.

**TESTERS, Fuel**
American Inst. Co.
Burrell Technical Supply
Central Scientific Co.
Cuthbert Co.
Emerson Apparatus Co.
Fish-Schurman Co.
Fisher Scientific Co.
Parr Instrument Co.
Phillips Petroleum
Precision Scientific
Riehle Div.
Sargent & Co.
Sturtevant Mill
Testing Machines, Inc.

**TESTERS Gage (See Gage Testers)**

**TESTERS, Gas (See Gas Analyzers)**

**TESTERS, Gear**
Dillon & Co.
Engineering Res. & Dev.
Fellows Gear Shaper
Ferner Co.
Krouse Testing Mach.
Morse Twist Drill
Olsen Testing Mach.
Scherr Co., Inc.

**TESTERS, Glue**
Central Scientific Co.
Dillon & Co.
Fish-Schurman Co.
Olsen Testing Machine
Physicists Research
Thwing-Albert Inst. Co.

**TESTERS, Grain**
Central Scientific Co.
Cuthbert Co.
Exact Weight Scale
Gump Co.
Menlo Research Lab.
Moist-O-Meter, Inc.
Moisture Register Co.

(Continued)

Newark Scale Works
Precision Scientific Co.
Seedburo Equipment
Tagliabue Div.
Toledo Scale Co.
Troemner, Henry

**TESTERS, Grease (See Grease Testing Apparatus)**

**TESTERS, Grinding Wheel**
Olsen Testing Machine

**TESTERS, Ground Resistance**
Associated Research
Automatic Electric Sales
Biddle Co., Jas. G.
Borden Engineering
General Electric Co.
Geophysical Inst. Co.
Gray Instrument
Heiland Research
Industrial Insts., Inc.
Instrument Labs.
Leeds & Northrup
Miller, M. C.
Niagra Electric
Roller Smith
Sensitive Res. Inst.

(Continued)

Shallcross Mfg.
Sherron Metallic
Sticht & Co.
Thwing-Albert
Winslow Co.

**TESTERS, Hardness of Grindable Materials**
Ames Precision Machine
Ferner Co.
Gardner Laboratory
Gordon Co., Claud S.
Riehle Testing Machines

**TESTERS, Hardness of Plastic Films**
Ferner Co.
Gordon Co., Claud S.
Munsell Color Co.
Precision Scientific
Steel City Testing
Taber Instrument Co.
Testing Machines, Inc.

**TESTERS, High Altitude (See Chambers, Instrument Test)**

**TESTERS, Hydrogen - Ion (See Hydrogen-Ion Determination Instruments)**

**TESTERS, Insulation**
Aircraft Electronics
American Transformer
Antenna Research Lab.
Associated Research
Automatic Elec. Chicago
Biddle Co., Jas. G.
Boonton Radio Corp.
Clough-Brengle Co.
Cole Instrument
Communication Meas. Lab
Dice Co., J. W.
Freed Transformer
General Elec. Co.
General Radio Co.
Geier & Bluhm
Hewlett-Packard
Hickok Elec. Inst.
Ideal Industries, Inc.
Industrial Insts., Inc.
Islip Radio Mfg.
Kellogg Switchboard
Leeds & Northrup Co.
Miller Co., Bertrand F.
Precise Measurements Co.
Radio Frequency Labs.
Rawson Electrical Inst.
Rubicon Co.
Scott Testers
Shallcross Mfg. Co.
Sherron Metallic
States Co.
Sticht Co.
Superior Insts.
Westinghouse Elec.
Weston Elec. Inst.
Winslow Co.

**TESTERS, Insulation (Thickness)**
Comtor Co.
Federal Products Corp.
General Elec. Co.

**TESTERS, Jelly**
Chatillon & Sons
Fish-Schurman Co.
Koehler Instrument
Precision Scientific

**TESTERS, Laundering**
Atlas Electric Devices

**TESTERS, Lens**
Engis Equipment
Gaertner Scientific
Mann Co., W. I.

**TESTERS, Magnetic**
Aero Electronics
American Inst. Co.
Annis Co.
Associated Research
Baird Associates
Dice Co., J. W.
General Elec. Co.
General Radio
Geophysical Inst. Co.
Instrument Labs.
Magnaflux Corp.
Magnetic Analysis Corp.
Pioneer Instrument
Rawson Elec. Instr. Co.
Rubicon Co.
Ruska Inst. Corp.
Sherron Metallic

**TESTERS, Malt**
Brabender Corp.
Rieker Instrument Co.
Seedburo Equipment

**TESTERS, Mica**
Boonton Radio Corp.

**TESTERS, Mileage (See Meters, Mileage)**

**TESTERS, Milk**
Central Scientific Co.
Kimble Glass
Koehler Instrument
Munsell Color Co., Inc.
Photovolt Corp.
Rieker Inst. Co.
Ruehfel Co.
Scientific Glass App.
Standard Elec. Time
Testrite Instrument Co.
Tagliabue Div.

**TESTERS, Moisture**
Aero Electronics
Alpha-Lux Co.
American Inst. Co.
Brabender Corp.
Brown Inst. Div.
Burrows Equipment Co.
Cambridge Inst. Co.
Central Scientific Co.
Cuthbert Co.
Delmhorst Instrument
Dietert Co.
Electronic Products Co.
Exact Weight Scale
Ferner Co.
Fielden Instrument
Fisher Scientific Co.
Food Technology, Inc.
General Elec. Co.
Hart Moisture Gages
H & H Thermostats
Humboldt Mfg. Co.
Industrial Inst., Inc.
Laboratory Equipment
Moisture Register Co.
Precision Scientific Co.
Rascher & Betzold
Refinery Supply Co.
Scientific Glass App.
Scientific Inst. (Detroit)
Seedburo Equipment
Shallcross Mfg. Co.
Tagliabue Div.
Tenney Engineering
Testing Machines, Inc.
Thwing-Albert Inst. Co.
Toledo Scale Co.
Troemner, Henry
Williams Apparatus Co.

**TESTERS, Mullen**
Testing Machines

**TESTERS, Non destructive electrical for physical properties**
Aero Electronics
Baldwin-Lima-Hamilton
Cady & Co.
Cole Instrument
Dice Co., J. W.
Electro Products Labs.
Ferner Co.
General Electric
General Radio
Hathaway Instrument
Magnaflux Corp.
Sheffield Corp.
Sperry Products
Thwing-Albert Inst. Co.

**TESTERS, Oil**
American Inst. Co.
Central Scientific Co.
Eitzen Co.
Fish-Schurman Co.
Gardner Laboratory
Gerin Corp.
Hellige, Inc.
Humboldt Mfg. Co.
Kimble Glass
Koehler Instrument
Laboratory Equipment
Menlo Research Lab.
Mico Instrument Co.
Precision Scientific Co.
Refrigeration Sys.
Rieker Inst. Co.
Ruehfel Co.
Ruska & Co.
Scientific Glass App.
Scientific Inst. Co.
Tagliabue Div.
Tenney Engineering

**TESTERS, Oxygen**
American Inst. Co.
Burrell Technical Supply
Central Scientific
Gadgets, Inc.
General Elec. Co.
Precision Scientific
Sargent & Co.
Scientific Glass App.
Scientific Inst. Co.
Tagliabue Div.

**TESTERS, Paint**
American Inst. Co.
Atlas Elec. Devices Co.
Boonton Radio Corp.
Central Scientific Co.
Dillon & Co.
Fish-Schurman Co.
Gardner Laboratory
General Elec. Co.
Instron Engg. Corp.
Koehler Instrument
Munsell Color Co.
Photovolt Corp.
Precision Scientific
Ruehfel Co.
Scott Testers
Taber Instrument Co.
Tenney Engineering
Thermo-Electric
Van Keuren Co.
Zuhr. Inc., Henry

**TESTERS, Paper Curl**
Thwing-Albert Inst. Co.

**TESTERS, Paper Formation**
Dillon & Co.
General Elec. Co.
Hart Moisture Gages
Testing Machines, Inc.
Thwing-Albert Inst. Co.
Williams Apparatus Co.

**TESTERS, Paraffin**
American Inst. Co.
Humboldt Mfg.
Koehler Instrument
Olsen Testing Mach.
Perkins & Son
Precision Scientific
Ruehfel Co.
Tagliabue Div.

**TESTERS, Penetration (Paper)**
General Electric
Olsen Testing Mach.
Riehle Testing Machines
Testing Machines, Inc.
Thwing-Albert Inst. Co.
Williams Apparatus Co.

**TESTERS, Petroleum (See Oil above)**

**TESTERS, Phosphate**
Hellige, Inc.
La Motte Chemical Prods.
Permutit Co.
Taylor & Co., W. A.

**TESTERS, Pistol Barrel Optical**
Kollmorgan Optical Co.
Lenox Inst. Co.
Scherr Co., Inc.
Schneider-Cogswell

**TESTERS, Piston Ring**
American Measuring Insts.
Gordon Co., Claud S.
Link Engineering
Toledo Scale Co.

**TESTERS, Pitch**
American Inst. Co.
Precision Scientific Co.

**TESTERS, Plasticity**
American Inst. Co.
Brabender Corp.
Dietert Co.
Dillon & Co.
Humboldt Mfg. Co.
Instron Eng. Corp.
Olsen Testing Machine
Precision Scientific Co.
Scott Testers, Inc.
Steel City Testing
Testing Machines, Inc.

**TESTERS, Porosity**
Ferner Co.
Gurley, W. & L. E.
Magnaflux Corp.
Perkins & Son
Precision Scientific
Ruska Instrument
Saxl Instrument
Testing Machines, Inc.
Thwing-Albert Inst. Co.
Westinghouse Elec.
Williams Apparatus Co.

**TESTERS, Pulp**
Hart Moisture Gage
Perkins & Son
Testing Machines, Inc.
Thwing-Albert Inst. Co.
Williams Apparatus Co.

**TESTERS, Radio Set (See Analyzers, Radio Set)**

**TESTERS, Radio Tube (See Analyzers, Radio Set)**

**TESTERS, Relay**
Arthur E. Booth
Eastern Specialty Co.
Electro-Physics
Standard Elec. Time
Weston Elec. Inst.
**TESTERS, Resistance**
Assembly Products
Associated Research, Inc.
Automatic Elec. Chicago
Beckman Instruments
Biddle Co., James G.
Boonton Radio Corp.
Borden Engineering
Brown Electro-Measurement
Cole Instrument
Communication Meas. Lab.
Dale Instruments
Electro-Tech Equipment
Electronic Dev. Lab.
Electronic Instrument
Feiler Engineering
Freed Transformer
General Elec. Co.
General Radio Co.
Gray Instrument Co.
Ideal Industries, Inc.
Industrial Instruments
Instrument Labs.
Leeds & Northrup Co.
Nosker Eng. Prod.
Radex Corp.
RCA
Riehle Testing Machines
Rubicon Co.
Shallcross Mfg. Co.
Simpson Electric
Sticht Co.
Supreme Instrument Corp.
Sylvania Elec. Prod.
Triplett Electrical Inst.
Westinghouse Elec.
Weston Electrical Inst.

**TESTERS, Salt Spray**
American Instrument Co.
Atlas Electric Devices
Industrial Filter

**TESTERS, Sand**
Chatillon & Sons
Dietert Co.
Exact Weight Scale Co.
Hart Moisture Gage
Humboldt Mfg. Co.
Precision Scientific

**TESTERS, Shutter**
Amer. Chronoscope
Triumph Mfg. Co.

**TESTERS, Slowness**
Testing Machines, Inc.
Williams Apparatus Co.

**TESTERS, Softness**
Dillon & Co.
Ferner Co.
Gurley, W. & L. E.
Humboldt Mfg. Co.
Olsen Testing Mach.
Precision Scientific
Riehle Testing Machines
Taber Instrument Co.
Thwing-Albert Inst. Co.

**TESTERS, Soil**
American Instrument
Associated Research
Kauffman-Lattimer
LaMotte Chemical Prod.
La Pine & Co., A. S.
Marconi Instruments Ltd.
Miller, M. C.

**TESTERS, Spark Plug**
Beam Instrument
Centralab Div.
Cole Instrument
General Cement Mfg.
Hickok Elec. Inst.
Schauer Mfg. Co.

**TESTERS, Strain (Glass)**
Baird Associates
Bausch & Lomb Opt.
Edin Electronics
Fecker, J. W.
Fish-Schurman Corp.
Gaertner Scientific Corp.
General Elec. Co.
Hathaway Instrument
Kollmorgan Optical Co.
Olsen Testing Mach.
Pfaltz & Bauer, Inc.
Plummer & Kershaw
Polarizing Instrument Co.
Precision Scientific
Zeiss, Inc., Carl

**TESTERS, Tachometer**
American Time Prods.
Amthor Testing Inst.
Associated Research
Biddle Co., Jas. G.
Consol. Ashcroft Hancock
Elec. Tachometer Corp.
(Continued)

Engineering Res. & Dev.
Flader Inc. Fredric
Gadgets Inc.
General Elec. Co.
Globe Industries
Ideal Lab. Tool
Pioneer Instrument
Precision Scientific
Rieker Inst. Co.
Rowe Engineering
Standard Elec. Time
Sticht Co.
Sun Manufacturing
Zeiss, Inc., Carl
Zernickow Co., O.

**TESTERS, Tenderness**
American Inst. Co.
Humboldt Mfg. Co.
Precision Scientific Co.

**TESTERS, Thermometer**
Amthor Testing Inst.
Consol. Ashcroft Hancock
Freas Glass Works
G. M. Mfg. Co.
Green, Henry J.
Ideal Lab. Tool
J-B-T Instruments
Kahl Scientific Inst.
Hiergesell & Sons
Huddleston, J. S. F.
Lewis Engineering
Manning, Maxwell, Moore
Moeller Instrument Co.
Nurnberg Thermometer
Palmer Co.
Ruehfel Co.
Schultheis Corp.
Tagliabue Div.
Thwing-Albert Inst. Co.
Wagner & Son
Weksler Thermometer

**TESTERS, Torque and Torque Wrench**
Airdraulics Engineering
Chatillon & Sons
Edin Electronics
Genisco Inc.
Olsen Testing Mach.
Skyway Precision Tool
Sturtevant Co.

**TESTERS, Turn Indicator**
Amthor Testing Inst. Co.
General Electric Co.
Genisco Inc.
Globe Industries
Ideal Lab. Tool
Pioneer Instrument
Rieker Instrument Co.
Ruehfel Co.
Standard Products
Summers Gyroscope

**TESTERS, Ultrasonic**
Audio-Tone Oscillator
Branson Instruments, Inc.
Dice Co., J. W.
Gen. Precision Lab.
Gulton Mfg. Co.
Radioactive Products
Sperry Products

**TESTERS, Vapor Transmission**
Thwing-Albert Inst. Co.

**TESTERS, Varnish**
Atlas Elec. Devices Co.
Dillon & Co.
Fish-Schurman Co.
Gardner Laboratory
Hellige, Inc.
Photovolt Corp.
Scott Testers
Taber Instrument Co.
Thermo Electric Co.
Zuhr, Inc., Henry

**TESTERS, Voltage**
Antenna Research Lab.
Associated Research
Ballantine Labs.
Clough-Brengle Co.
Cole Instrument
Electrical Facilities, Inc.
Electronic Associates
Electronic Dev. Lab.
Esterline-Angus
Feiler Engineering
Fox Valley Inst.
General Elec. Co.
Ideal Industries, Inc.
Instrument Labs.
Islip Radio Mfg.
Lyman Electronic
MacLeod & Hanopol
Norton Electrical Inst.
Precise Measurements
Precision Apparatus
Potter Co.
RCA
Shallcross Mfg. Co.
Sherron Metallic
Standard Products Inc.
Sticht Co.
Sylvania Elec. Prod.
Trenton Transformer
Triplett Elec. Inst.

**TESTERS, Watch Rate**
American Time Prods.
Paulson & Co.
Potter Instrument

**TESTERS, Water Meter**
Badger Meter Co.
Barnstead Still
Exact Weight Scale
Fischer & Porter
Neptune Meter Co.
Toledo Scale Co.

**TESTERS, Water Penetration**
Biddle Co., Jas. G.
Hart Moisture Gage
Thwing-Albert Inst. Co.
Williams Apparatus
**TESTERS, Watthour Meter**
Duncan Elec. Mfg.
Eastern Specialty Co.
(Continued)

Biddle

SPECIALIZED TESTING INSTRUMENTS...

For rehabilitation, maintenance and special investigations . . . rugged and dependable . . . direct-reading and simple. . . . We offer our literature, our personal assistance and our instrument specialties for the solution of your testing problems.

**For Insulation Resistance.** "Megger" Insulation Testers — Hand driven, Motor driven, "Meg," "Bridge-Meg," "Rectifier Operated" and Midget Types. *Bulletin 21-05-I*

**For Ground Resistance.** "Megger" and "Meg" Ground Testers. *Catalog 25-I*

**For Conductor Resistance.** "Ducter" Low Resistance Ohmmeters—down to .000001 ohm. *Bulletin 24-25-I*

Bridge-Meg —-up to 1000 megohms. *Bulletin 21-60-I*

Midget "Megger" Circuit Testing Ohmmeters—0.1—200,000 ohms. *Bulletin 21-85-I*

**To Measure Speed, Frequency and Rates of Vibration.** "Frahm" Vibrating Reed Frequency Meters. *Bulletin 32-I*

"Frahm" Vibrating Reed Tachometers and Vibration Indicators. *Bulletin 31-I*

**"Jagabi" Precision Tachometers,** Centrifugal and Chronometric types for hand use. *Bulletin 35-I*

"Dr. Horn" Tachometers. *Bulletin 35-65-I*

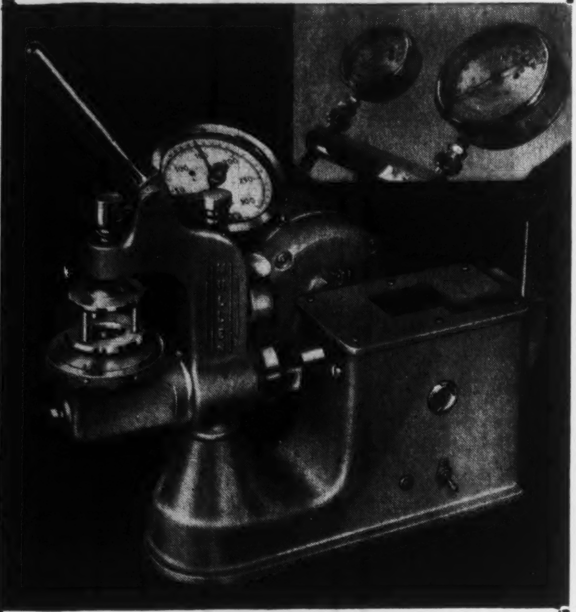
**"Jagabi" Slide Wire and Carbon Rheostats.** Wide variety of types and ratings. *Bulletin 41-I*

Also Apiezon Oils, Greases, Waxes, for high vacuum work; "Pointolite" Lamps. Write for literature.

JAMES G. BIDDLE CO.
Electrical & Scientific Instruments
1316 ARCH STREET, PHILADELPHIA 7, PA

*Mullen Test*

*Recognized the world over as standard bursting test*



Model C Mullen Tester (illustrated) for testing materials not exceeding .025" in thickness and a bursting strength of 200 pounds. Gauge capacities 30, 60, 120 and 200 pounds per square inch.

Model A, motor driven, for testing specimens with bursting strengths above 200 p.s.i. Especially designed for testing corrugated as well as other materials.

The Mullen Tester operates on the hydraulic principle—bursting strengths are determined irrespective of any other factor. Conforms to ASTM and TAPPI standards.

◆

**B. F. PERKINS & SON, Inc.**

***Engineers and Manufacturers***

Holyoke, Massachusetts

Elec. Facilities, Inc.
General Elec. Co.
Hathaway Inst. Co.
Rockwell Engr.
Sangamo Electric Co.
States Co.
Westinghouse Elec.

### TESTERS, Weathering

Anetsberger Bros.
Atlas Elec. Devices Co.
Electric Hotpack Co.
Gen. Elec. Lamp Dept.
National Carbon Co.
Precision Scientific
Standard Cabinet Co.
Tenney Engineering

### TESTING INSTRUMENTS, Optical

Acme Industrial
American Meas. Insts.
American Optical
Bausch & Lomb Optical
E & S Optical
Ferner Co.
Fish-Schurman Corp.
Gaertner Scientific Corp.
Gardner Laboratory
Geophysical Inst. Co.
Gordon Co.
Instrument Dev. Labs.
Jones & Lamson Machine
Kollmorgen Optical Co.
Larrimore Sales
Leitz, Inc.
Mann, W. I.
Optical Service & Dev.
Optron Laboratory
Palos Optical Co.
Perkin-Elmer Corp.
Phoenix Prec. Inst.
Precision Scientific
Pyrometer Inst. Co.
Unertl Optical Co.

### TESTING MACHINES, Alternating Stress

Baldwin-Lima-Hamilton
Brush Development Co.
Edin Electronics
Emery Co., A. H.
Hathaway Instrument
Krouse Testing Machine
Olsen Testing Machine
Riehle Div.

### TESTING MACHINES, Bearing

Olsen Testing Machine
Physicists Research
Precision Scientific
RCA Manufacturing Co.

### TESTING MACHINES, Bending

Baldwin-Lima-Hamilton
Detroit Testing Mach.
Dillon & Co.
Dorr-Patterson Engr.
Ferner Co.
Hayes Scientific App.
Krouse Testing Mach.
Olsen Testing Machine
Riehle Testing Machines
Steel City Testing Machine
Taber Instrument Co.
Thwing-Albert Inst.

### TESTING MACHINES, Brinell

Ames Precision Machine
Detroit Testing Mach.
DoAll Co.
Ferner Co.
King, Andrew
Olsen Testing Machine
Pittsburgh Inst. & Mach.
Riehle Testing Machines
Steel City Testing Machine
Testing Machines, Inc.

### TESTING MACHINES, Brittleness

Baldwin-Lima-Hamilton
Olsen Testing Mach.
Precision Scientific
Riehle Testing Machines

### TESTING MACHINES, Bursting

Amthor Testing Inst. Co.
Autoclave Engineers
Cady & Co., E. F.
Mansfield & Green
Olsen Testing Mach.
Parks Co., Harry S.
Perkins & Son, Inc.
Riehle Testing Machines
Scott Testers
Testing Machines, Inc.
Thwing-Albert Inst.

### TESTING MACHINES, Cable

Aircraft Electronics
Amthor Testing Inst.
Associated Research
Baldwin-Lima-Hamilton
Berkshire Laboratories
Boulin Instrument Corp.
Century Geophysical
Chatillon & Sons
Communication Meas. Lab.
Dillon & Co.
Emery Co., A. H.
Feiler Engineering
General Elec. Co.
Kellogg Switchboard
Krouse Testing Mach.
Leeds & Northrup Co.
Olsen Testing Machine
Pacific Scientific Co.
Perkins & Son
Riehle Testing Machines
Rubicon Co.
Scott Testers
Shallcross Mfg. Co.
Sherron Metallic
Steel City Testing Mach.
Thordarson Elec. Mfg.
Thwing-Albert Inst.

### TESTING MACHINES, Cement

American Inst. Co.
Baldwin-Lima-Hamilton
Borden Engineering
Bowen & Co.
Burrell Tech. Supply
Carver, Fred S.
Central Scientific Co.
Dillon & Co.
Electro Products Labs.
Emery Co., A. H.
Exact Weight Scale Co.
Federal Pneumatic Sys.
Fisher Scientific Co.
Hayes Scientific App.
Humboldt Mfg. Co.
Olsen Testing Machine
Precision Scientific Co.
Refinery Supply Co.
Riehle Testing Machines
Scientific Inst. Co.
Scott Testers
Western Machinery Co.
Yoder Company

### TESTING MACHINES, Chain

Baldwin-Lima-Hamilton
Dillon & Co.
Emery Co. A, H.
Krouse Testing Mach.
Olsen Testing Mach.
Riehle Testing Machines
Steel City Testing Mach.

### TESTING MACHINES, Compression

Baldwin-Lima-Hamilton
Carver, Fred S.
Chatillon & Sons
Detroit Testing Mach.
Dillon & Co.
Dorr-Patterson Engr. Co.
Electro Products Labs.
Emery Co., A. H.
Engineers Specialty Div.
Exact Weight Scale Co.
Ferner Co.
Krouse Testing Mach.
Link Engineering
Olsen Testing Machine
Perkins & Son, Inc.
Potter Co.
Precision Scientific
RCA Manufacturing
Riehle Testing Machines
Scott Testers
Schauer Mfg. Co.
Steel City Testing Mach.
Testing Machines, Inc.
Toledo Scale Co.
Thwing-Albert Inst.

### TESTING MACHINES, Concrete (See Cement above)

### TESTING MACHINES, Creep

Baldwin-Lima-Hamilton
Ferner Co.
Gaertner Scientific Corp.
Marshall, L. H.
Olsen Testing Machine
Riehle Testing Machines

### TESTING MACHINES, Damping

Baldwin-Lima-Hamilton
M. B. Mfg. Co.

### TESTING MACHINES, Deflection

Chatillon & Son
Electro Products Lab.
Link Engineering
Olsen Testing Mach.
Riehle Testing Machines
Scott Testers
Steel City Testing Mach.

### TESTING MACHINES, Diaphragms

Dice Co., J. W.
Krouse Testing Mach.

### TESTING MACHINES, Ductility

Bock Machine Co.
Central Scientific Co.
Dillon & Co.
Detroit Testing Mach.
Edwards, L. V.
Humboldt Mfg. Co.
Olsen Testing Machine
Precision Scientific Co.
Riehle Testing Machine
Scott Testers
Steel City Testing Mach.
Testing Machines, Inc.

### TESTING MACHINES, Fatigue

All American Tool
Baldwin-Lima-Hamilton
Ferner Co.
General Elec. Co.
Hathaway Inst. Co.
Hays Scientific App.
Krouse Testing Mach.
L. A. B. Corp.
Link Engineering
Martin-Hubbard Corp.
M. B. Mfg. Co.
Minnesota Electronics
Olsen Testing Machine
Precision Scientific
Riehle Testing Machine
Ruehfel Co.
Scott Testers
Taller & Cooper
Testing Machines, Inc.
Westinghouse Elec.

### TESTING MACHINES, Folding Endurance (Paper)

American Inst. Co.
Amthor Testing Inst. Co.
General Electric
Olsen Testing Machine
Riehle Testing Machines
Testing Machines, Inc.
Thwing-Albert Inst. Co.

### TESTING MACHINES, Gummed Tape

Amthor Testing Inst.
Dillon & Co.
Scott Testers
Thwing-Abert Inst. Co.

### TESTING MACHINES, Hardness

American Optical
Ames Precision Machine
Barber-Colman Co.
Clark Instrument
Detroit Testing Mach.
Dietert Co.
Eberbach & Son
Eitzen Co.
Erb & Gray
Ferner Co.
Fisher Scientific Co.
General Elec. Co.
Gogan Machine
Gordon Co., Claud S.
Kent Cliff Labs.
King, Andrew
Leitz, Inc.
Olsen Testing Machine
Pittsburgh Inst. & Mach.
Precision Scientific
Riehle Testing Machine
Rubicon Co.
Shore Instrument
Steel City Testing Mach.
Swedish Gage
Testing Machines, Inc.
Tapfight Tape Co.
Webster Inst.
Wilson Mech. Inst.
Zeiss, Inc., Carl

### TESTING MACHINES, High Pressure, for Hose Lines & hydraulic devices

Electro Products Labs.
Hydraulic Controls
Mansfield & Green
Parks Co., Harry S.
Steel City Testing Mach.

### TESTING MACHINES, Impact

Analysis Sales Co.
Baldwin-Lima-Hamilton
Cambridge Inst. Co.
Ferner Co.
Gadgets Inc.
Gordon Co., Claud S.
Gorrell & Gorrell
Impact Register Co.
L. A. B. Corp.
Olsen Testing Machine
Precision Scientific
Radio Frequency Labs.
Riehle Testing Machine
Scott Testers
Size Control Co.
Steel City Testing Mach.
Testing Machines, Inc.
Thwing-Albert Inst.

### TESTING MACHINES, Initial Tearing

Precision Scientific
Scott Co., Henry L.
Suter, Alfred
Testing Machines, Inc.
Thwing-Albert Inst. Co.

### TESTING MACHINES, Knit Goods (See Textile below)

### TESTING MACHINES, Leather

Amthor Testing Inst. Co.
Central Scientific Co.
Dillon & Co.
Olsen Testing Machine
Perkins & Son
Riehle Testing Machines
Scott Testers
Taber Instrument Co.

### TESTING MACHINES, Paper

American Inst. Co.
Amthor Testing Inst. Co.
Atlas Elec. Devices
Bausch & Lomb
Cady & Co., E. J.
Central Scientific Co.
Dietert Co.
Dillon & Co.
Emerson Apparatus Co.
Federal Prod. Corp.
Ferner Co.
Gardner Laboratory
General Elec. Co.
Gurley, W. & L. E.
Hart Moisture Gage
Instron Engg. Corp.
Olsen Testing Machine
Perkins & Son
Photovolt Corp.
Riehle Testing Machines
Scott Testers
Speidel & Co.
Steel City Testing
Taber Instrument Co.
Testing Machines, Inc.
Thwing-Albert Inst. Co.
Toledo Scale Co.
Van Keuren Co.
Williams Apparatus Co.

### TESTING MACHINES, Pipe & Tube

Baldwin Locomotive
Black & Decker
Branson Instruments

(Continued)

HARDNESS TESTING...

done WITH NO MENTAL HAZARDS. The SCLEROSCOPE has done it for the past 42 years.

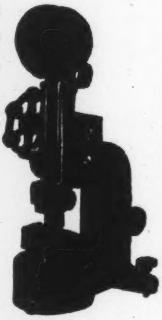
In general use for specification purposes. Simple, sturdy. Comparatively inexpensive.

•

*Illustrated bulletins free*

**The Shore Instrument & Mfg. Co., Inc.**

90-35 Van Wyck Expressway
Jamaica 2, N. Y.



Like a Phantom Finger

the Branson non-destructive Thickness Testers probe metal from one side—quickly and accurately.

the AUDIGAGE® THICKNESS TESTER

*Ultrasonic Resonance* eliminates slow and costly drill-and-plug in checking the progress of corrosion in tanks, pipes, ships' hulls and other difficult or inaccessible locations. Gages thickness of non-porous materials from 1/16-inch to 12 inches with flat or curved surfaces; detects laminar flaws. Portable and self-powered—light and rugged for field use, precise enough for the laboratory. Accurate within 3%, 10-to-50 times faster than older methods.

the AUDIGAGE® FLAW DETECTOR

Proven from coast to coast by dozens of railroads, has scores of uses beyond its original sleuthing of defective rails, frogs and crossings. Like the THICKNESS TESTER, portable and rugged; *Ultrasonic Resonance* probes from one side for laminar flaws, other defects in non-porous materials. Very compact, portable, self-powered.

the BRANSON COATINGAGE

Calipers non-magnetic coatings, scale, coke, etc., from 0.0001 inch to 0.5 inch thick on iron or steel. Compact, portable, self-powered, precise; for field and laboratory.

For full information on AUDIGAGE® THICKNESS TESTERS and FLAW DETECTORS, and the BRANSON COATINGAGE address

**BRANSON INSTRUMENTS, INC.,**

DEPARTMENT II — STAMFORD, CONN., USA

ELEMENTARY ENGINEERING ELECTRONICS

*With Special Reference to Measurement and Control*

By ANDREW W. KRAMER

Managing Editor *Power Plant Engineering*, Member American Institute of Electrical Engineers, Associate Member Institute of Radio Engineers.

*Cloth, 344 pages, 259 illustrations, $2 postpaid*

This is a PRACTICAL treatment of principles and applications. It is NON-MATHEMATICAL—no equations beyond elementary-algebra level in the text—fewer than a dozen of these to be learned.

***Acquire a better knowledge of electronics without trying to be a radio engineer.***

ORDER THIS UNIQUE BOOK NOW

Check, money order or cash must accompany order

INSTRUMENTS PUBLISHING CO.
921 Ridge Ave. Pittsburgh 12, Penna.

VIBRATION Fatigue Tests POINT THE WAY TO IMPROVED PRODUCTS

**MODEL 100VA**
CAPACITY 100 LBS.
Produces Vibrations Vertically. All Controls In Easy Reach.

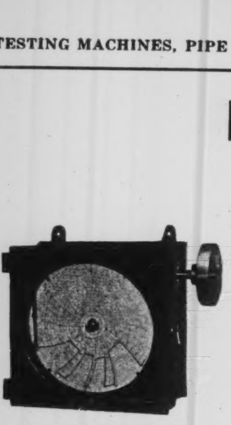
You can be sure if your products pass a vibration fatigue test—substantiates design and construction materials—frequently exposes excessive material. Many things can be learned from tests. A "must" for electronic, aircraft and automotive parts and assemblies. Hundreds in use. Models to handle parts from 10 lbs. to 100 lbs.—choice of vertical or horizontal table movement. Frequencies of 600 to 3,600 v.p.m. Special machines to order. Catalog F contains treatise.

Made by makers of ALL AMERICAN PRECISION DIE FILING MACHINES

**ALL AMERICAN Tool & Manufacturing Co.**

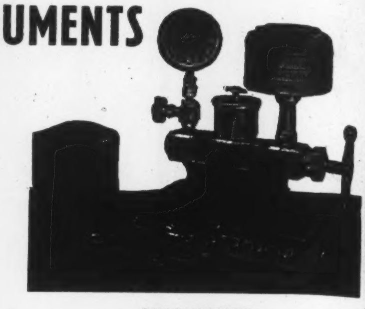
1015 FULLERTON AVE. Chicago, Ill.

PLANT and LABORATORY INSTRUMENTS



PAPER MACHINE TACHOMETERS. (Recording and Indicating)

TENSILE STRENGTH TESTERS FOR PAPER, CORDAGE, RUBBER, WIRE, ETC. VARIOUS MODELS AVAILABLE UP TO 1,500 LBS. MAX. CAPACITY



DEAD WEIGHT PRESSURE GAUGE TESTERS VARIOUS CAPACITIES UP TO 10,000 LBS./SQ. INCH

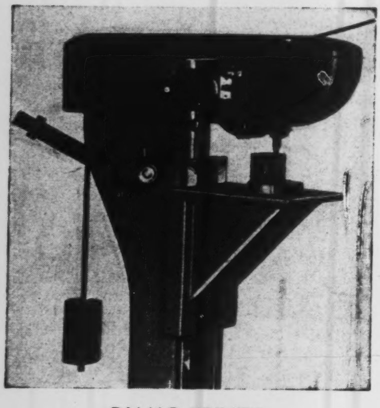
DEAD WEIGHT THICKNESS GAUGE 1/10,000 DIV.

FIVE RANGE HAND TACHOMETERS

ALSO— PAPER BURSTING STRENGTH TESTERS
POCKET AND DESK SCALES (Paper and Cordage)
PAPER MICROMETERS (Desk and Pocket)
ALUMINUM FOIL SCALES
SPECIAL INSTRUMENTS MANUFACTURED TO YOUR SPECIFICATIONS

Amthor Testing Instrument Co., Inc.
49a Van Sinderen Avenue, Brooklyn, N. Y.

HARDNESS TESTER
(Vickers Type)



DIAMO-BRINELL
TESTING MACHINES FOR
HARD AND SOFT METALS

*Ask for catalog on*
HAND AND POWER-OPERATED
BRINELL TESTERS

PITTSBURGH
Instrument & Machine Co.
1026 Reedsdale St. Pittsburgh, Pa.

Dillon & Co.
Geotechnical Corp.
Krouse Testing Mach.
Magnaflux Corp.
Olsen Testing Machine
Riehle Testing Machine
Steel City Testing Mach.

### TESTING MACHINES, Rails

Sperry Products, Inc.

### TESTING MACHINES, Road Material (See Cement above)

### TESTING MACHINES, Rubber

American Inst. Co.
Amthor Testing Inst.
Atlas Elec. Devices
Brabender Corp.
Central Scientific Co.
Clarkston Corp.
Dillon & Co.
Emerson Apparatus Co.
Federal Prod Corp.
Ferner Co.
Fish-Schurman Co.
Gordon Co., Claud S.
Instron Eng. Corp.
Link Eng.
MacDonald Co., W. S.
Olsen Testing Machine
Precision Scientific
Riehle Testing Machines
Scott Testers
Shore Instrument
Steel City Testing
Taber Inst. Corp.
Van Keuren Co.

### TESTING MACHINES, Scratch Hardness

American Optical Co.
Dietert Co.
Olsen Testing Mach.
Steel City Testing
Taber Inst. Co.
Testing Mashines, Inc.

### TESTING MACHINES, Shearing

Baldwin-Lima-Hamilton
Dillon & Co.
Ferner Co.
Humboldt Mfg. Co.
Olsen Testing Machine
Riehle Testing Machines
Steel City Testing Mach.

### TESTING MACHINES, Sheet Metal

Ames Precision Machine
Baldwin-Lima-Hamilton
Bock Machine Co.
Branson Instruments
Detroit Testing Mach.

(Continued)

Dillon & Co.
Krouse Testing Machine
Olsen Testing Machine
Pittsburgh Inst. & Mach.
Riehe Testing Machines
Scott Testers
Steel City Testing Mach.
Taber Instrument Co.

### TESTING MACHINES, Spring

Baldwin-Lima-Hamilton
Carver, Fred S.
Chatillon & Sons
Detroit Testing Mach.
Dillon & Co.
Exact Weight Scale
Federal Products Corp.
Gordon Co., Claud S.
Instron Eng. Corp.
Link Engineering
Olsen Testing Machine
Pelouze Mfg. Co.
Riehle Testing Machines
Scott Testers
Steel City Testing Mach.
Sturtevant Co.
Toledo Scale Co.

### TESTING MACHINES, Stiffness ( Paper)

American Inst. Co.
Dillon & Co.
Ferner Co.
Olsen Testing Machine
Riehle Testing Machines
Taber Instrument Co.
Testing Machines, Inc.
Thwing-Albert Inst. Co.
Toledo Scale Co.

### TESTING MACHINES, Stiffness & Bending

Dillon & Co.
Ferner Co.
General Elec. Co.
Instron Eng. Corp.
Krouse Testing Mach.
Olsen Testing Machine
Precision Scientific
Riehle Testing Machines
Steel City Testing Mach.
Taber Instrument Co.
Thwing-Albert Inst. Co.
Toledo Scale Co.

### TESTING MACHINES, Stretch

Amthor Testing Inst. Co.
Dillon Co.
Link Engineering
Olsen Testing Mach.
Pelouze Mfg. Co.
Perkins & Son
Riehle Testing Machines
Scott Testers
Thwing-Albert Inst. Co.

### TESTING MACHINES, Tearing Paper

General Elec. Co.
Instron Eng. Corp.
Riehle Testing Machine
Scott Testers
Testing Machines, Inc.
Thwing-Albert Inst. Co.

### TESTING MACHINES, Textile

American Inst. Co.
Atlas Elec. Devices Co.
Dillon & Co.
Emerson Apparatus Co.
Geier & Bluhm
Hart Moisture Gage
Instron Eng. Corp.
Mico Instrument
Norcross Corp.
Olsen Testing Mach.
Pelouze Mfg. Co.
Perkins & Son
Riehle Testing Machine
Saxl Instrument
Shawmut Eng. Co.
Scott Testers
Suter, Alfred
Taber Instrument Co.
Thwing-Albert Inst. Co.

### TESTING MACHINES, Thread

Boulin Instrument Corp.
Chatillon & Son
Dillon & Co.
Norcross Corp.
Olsen Testing Mach.
Schaevitz Engg.
Saxl Instrument
Suter, Alfred
Thwing-Albert Inst. Co.

### TESTING MACHINES, Torsion

Airdraulics Engineering
Baldwin-Lima-Hamilton
Boulin Instrument Corp.
Chatillon & Sons
Consolidated Engg.
Detroit Testing Mach.
Emery Co., A. H.
Exact Weight Scale
General Electric Co.
Hathaway Inst. Co.
Hayes Scientific App.
Krouse Testing Mach.
Link Engineering
Martin-Hubbard Corp.
Metron Instrument
Olsen Testing Mach.
Pelouze Mfg. Co.
Riehle Testing Machines
Scott Testers, Inc.
Steel City Testing
Sturtevant Co.
Testing Machines, Inc.
Toledo Scale Co.
Vectron, Inc.

### TESTING MACHINES, Torsional Creep

Baldwin-Lima-Hamilton
Riehle Testing Machines

### TESTING MACHINES UNIVERSAL, Dead weight beam, Capacities 0-100 lb.

Dietert Co.
Ferner Co.
Gordon Co., Claud S.
Olsen Testing Machine
Refinery Supply
Riehle Testing Machines
Thwing-Albert Inst.

### TESTING MACHINES, UNIVERSAL, Dead Weight Beam, Capacities 100-5000 lb.

Gordon Co., Claud S.
Olsen Testing Machine
Refinery Supply
Riehle Testing Machines
Scott Testers, Inc.
Thwing-Albert Inst.

### TESTING MACHINES, UNIVERSAL, Dead weight beam, Capacities 5000-100,000 lb.

Gordon Co., Claud S.
Olsen Testing Mach.
Riehle Testing Machines

### TESTING MACHINES, UNIVERSAL, Dead weight beam, Capacities over 100,000 lb.

Baldwin-Lima-Hamilton
Gordon Co., Claud S.
Olsen Testing Machine
Riehle Testing Machines

### TESTING MACHINES, Universal, Hydraulic, Capacities 0-100 lb.

Dietert Co., Harry W.
Electro Products Labs.
Emery Co., A. H.
Gordon Co., Claud S.
Olsen Testing Mach.
Riehle Testing Machines
Steel City Testing Mach.
Thwing-Albert Instrument

### TESTING MACHINES, Universal, Hydraulic, Capacities 100-5000 lb.

Baldwin-Lima-Hamilton
Detroit Testing Machine
Dietert Co., Harry W.
Electro Products Labs.
Emery Co.
Ferner Co.
Gordon Co., Claud S.
Olsen Testing Mach.
Riehle Testing Machines
Steel City Testing Mach.
Vectron, Inc.

**TESTING MACHINES, Universal, Hydraulic, Capacities 5000-100,000 lb.**
Baldwin-Lima-Hamilton
Detroit Testing Mach.
Emery Co., A. H.
Gordon Co., Claud S.
Olsen Testing Mach.
Pittsburgh Instrument
Riehle Testing Machines
Steel City Testing Mach.
Testing Machines, Inc.
Wroble Engineering Co.

**TESTING MACHINES, Universal, Hydraulic, Capacities over 100,000 lb.**
Baldwin-Lima-Hamilton
Emery Co., A. H.
Gordon Co., Claud S.
Olsen Testing Mach.
Riehle Testing Machines

**TESTING MACHINES Universal Pendulum, Capacities 0-100 lb.**
Amthor Testing Inst. Co.
Dietert Co.
Dillon & Co.
Gordon Co., Claud S.
Olsen Testing Mach.
Riehle Testing Machines
Scott Testers, Inc.
Steel City Testing
Suter, Alfred
Thwing-Albert Inst. Co.

**TESTING MACHINES, UNIVERSAL. Pendulum. Capacities 100-5000 lb.**
Amthor Testing Inst. Co.
Dietert Co.
Gordon Co., Claud S.
Olsen Testing Machine
Riehle Testing Machines
Scott Testers. Inc.
Steel City Testing
Testing Machines, Inc.

**TESTING MACHINES, UNIVERSAL. Pendulum. Capacities 5000-100,000 lb.**
Gordon Co., Claud S.
Olsen Testing Machine
Riehle Testing Machines
Steel City Testing

**TESTING MACHINES, UNIVERSAL. Pendulum. Capacities over 100,000 lb.**
Olsen Testing Machine
Riehle Testing Machines
Steel City Testing

**TESTING MACHINES, UNIVERSAL, Spring Dynamometers, Capacities 0-100 lb.**
Baldwin-Lima-Hamilton
Chatillon & Sons
Gordon Co., Claud S.
Olsen Testing Mach.
Riehle Testing Machines
Scott Testers, Inc.
Stoelting Co., C. H.
Thwing-Albert Inst. Co.
Toledo Scale Co.

**TESTING MACHINES, UNIVERSAL, Spring Dynamometers, Capacities 100-5000 lb.**
Baldwin-Lima-Hamilton
Chatillon & Sons
Dillon & Co.
Dietert Co.
Dorr-Patterson Eng.
Gordon Co., Claud S.
Hayes Scientific App.
Olsen Testing Mach.
Riehle Testing Machines
Scott Testers, Inc.
Stoelting Co., C. H.
Toledo Scale Co.

**TESTING MACHINES, UNIVERSAL, Spring Dynamometers, Capacities 500-100,000 lb.**
Baldwin-Lima-Hamilton
Chatillon & Sons
Dillon & Co.
Gordon Co., Claud S.
Olsen Testing Mach.
Riehle Testing Machines
Scott Testers, Inc.
Toledo Scale Co.

**TESTING MACHINES, UNIVERSAL, Spring Dynamometer, Capacities over 100,000 lb.**
Baldwin-Lima-Hamilton
Gordon Co., Claud S.
Olsen Testing Mach.
Toledo Scale Co.

**TESTING MACHINES, Vibration**
All Amer. Tool & Mfg.
Associated Research
Biddle Co.
Brush Development Co.
Calidyne Co.
Century Geophysical
Commercial Research
Electro-Mec Lab.
Electro Products Lab.
Engineering Res. & Dev.
Ferner Co.
General Elec. Co.
General Radio
Hathaway Instrument
Heiland Research
Krouse Testing Machine
L. A. B. Corp.
Lion Mfg., Inc.
Martin-Hubbard Corp.
M. B. Mfg. Co.
RCA Manufacturing
Rollin Co.
Sticht Co.
Walkirt Co.
Westinghouse Elec.

**TESTING MACHINES, Wire**
Amthor Testing Inst. Co.
Baldwin-Lima-Hamilton
Dillon & Co.
General Elec. Co.
Instron Eng. Corp.
Krouse Testing Mach.
Norcross Corp.
Olsen Testing Machine
Riehle Testing Machines
Rubicon Co.
Scott Testers, Inc.
Steel City Testing
Taber Instrument Co.
Thwing-Albert Inst. Co.

**TESTING MACHINES, Yarn**
Atlas Elec. Devices Co.
Brown Inst. Div.
Chatillon & Son
Dillon & Co.
Emerson Apparatus Co.
Hart Moisture Gage
Instron Eng. Corp.
Olsen Testing Mach.
Saxl Instrument
Schaevitz Engineering
Scott Testers, Inc.
Suter, Alfred
Testing Machines, Inc.
Thwing-Albert Inst. Co.

**TESTING SETS (See also object of measurement and control)**

**TESTING SETS, Alcohol**
Fischer & Porter
G. M. Mfg. Co., Inc.
Griebel Co.
Kahl Scientific Inst.
Precision Therm.
Rascher & Betzold
Ruehfel Co.
Scientific Glass App.
Tagliabue Div.
Weksler Thermometer

**TESTING SETS, Automotive**
Beam Instrument
Clough-Brengle Co.
Englehard Chas.
Fox Valley Inst.
Gow-Mac Instrument
Hays Corp.
Neihoff & Co.
Potter Co.
Westberg Mfg. Co.

**TESTING SETS, Cable**
Automatic Elec. Chicago
Biddle Co., James G.
Century Geophysical
Communication Meas. Lab.
Eastern Specialty
Feiler Engineering
General Elec. Co.
General Radio Co.
Leeds & Northrup
Littlefuse, Inc.
Rubicon Co.
Shallcross Mfg.
Sherron Metallic
Westinghouse Elec.
Winslow Co.

**TESTING SETS, Communication Circuits**
Automatic Elec. Chicago
Bell & Howell
Clough-Brengle
Collins Radio Co.
Daven Co.
Electronic Dec. Lab.
Electro Products Labs.
Feiler Engineering
Freed Transformer
Hewlett-Packard
Kellogg Switchboard
Leeds & Northrup
Littlefuse, Inc.
Meters, Inc.
Precision Apparatus
Radio City Products
Reiner Electronics
Rubicon Co.
Shallcross Mfg.
Sherron Metallic
Simpson Electric
Sylvania Elec. Prod.
Technology Inst. Corp.
Weston Elec. Inst. Corp.
Winslow Co.

**TESTING SETS, Current Transformer**
Assembly Products
Elec. Facilities Inc.
Federal Telegraph Co.
Feiler Engineering
General Electric Co.
Leeds & Northrup
Rubicon Co.
Sherron Metallic
States Co.
Thordarson Elec. Mfg.

**TESTING SETS, Electrical**
Aero Electronics
American Transformer
Associated Research
Automatic Elec. Chicago
**Biddle Co., James G.**
**Bradshaw Instruments**
Clarke Inst. Corp.
Clough-Brengle Co.
Columbia Elec. Mfg.
Communication Meas. Lab.
Dale Instruments
Dice Co., J. W.
Eastern Specialty
Elec. Facilities, Inc.
Electronic Dev. Lab.
Electronic Instrument
Esterline-Angus
Feiler Engineering
Gadgets Inc.
General Elec. Co.
Gray Instrument
Hewlett-Packard
Industrial Inst., Inc.
Kay Electric
Link Engineering
Meter Devices Co.
Potter Instrument
Precision Apparatus
Rawson Elec. Inst. Co.
RCA Mfg. Co.
Roller-Smith Co.
Rubicon Co.
Sensitive Research Inst.
Shallcross Mfg. Co
Sherron Metallic
Sticht Co
Superior Electric Co
Tobe Deutschmann Corp.
Triplett Elec. Inst.
Westinghouse Elec.
Weston Elec. Inst. Corp.
Winslow Co.

**TESTING SETS, Electrical Thermometer**
**Brown Inst. Div.**
Feiler Engineering
Gadget Inc.
Gray Instrument
Leeds & Northrup
Rubicon Co.
Shallcross Mfg. Co.
Sherron Metallic
Tagliabue Div.
Thwing-Albert Instrument
Winslow Co.

**TESTING SETS, Ground Resistance (See Tester, Ground Resistance)**

**TESTING SETS, Insulation, (see Testers, Insulation)**

**TESTING SETS, Line Current**
Associated Research
Automatic Elec. Chicago
Cole Instrument
Columbia Elec. Mfg.
Elec. Facilities, Inc.
Electronic Development
Esterline Angus
Feiler Engineering
General Elec. Co.
Gray Instrument
Hickok Elec. Inst.
Meter Devices Co.
Precision Apparatus
Roller-Smith
Rubicon Co.
Sherron Metallic
**Sticht Co.**
Triplett Elec. Inst.
Weston Elec. Inst. Corp.

**TESTING SETS, Meters, Electrical**
Assembly Products
Associated Research
Automatic Elec. Chicago
Beckman Instruments
Booth Co., Arthur H.
Chicago Indust. Inst.
Clippard Inst. Lab.
Clough-Brengle Co.
Cole Instrument
Douglas Radio Labs.
Eastern Specialty Co.
Elec. Facilities, Inc.
Electronic Dev. Lab.
Esterline Angus
Feiler Engineering
General Elec. Co.
Gray Instrument
Hathaway Instrument
Hewlett-Packard
Precise Measurements Co.
Radio City Products
Rawson Elec. Inst. Co.
RCA Manufacturering Co.
Reiner Electronics
Roller-Smith
Rubicon Co.
Sensitive Research Inst.
Shallcross Mfg. Co.
Sherron Metallic
States Co.
Sticht Co.
Stratex Instrument Co.
Thwing-Albert Inst. Co.
Triplett Elec. Inst.
Westinghouse Elec.
Weston Elec. Inst. Co.

**TESTING SETS, Meters, Fluid**
American Meter Co.
Bailey Meter Co.
Fischer & Porter
Tagliabue Div.

**TESTING SETS, Portable Combustion**
Dwyer Mfg. Co.
Engelhard, Chas.
Hays Corp.

**TESTING SETS, Potential transformer**
Eastern Specialty Co.
Elec. Facilities, Inc.
General Elec. Co.
Leeds & Northrup Co.
Raytheon Mfg. Co.
Sherron Metallic

**TESTING SETS, Surface Roughness**
Surface Checking Gage

**TESTING SETS, Telephone**
Automatic Elec. Chicago
Bradshaw Instruments
Daven Co.
Electronic Development
Federal Telegraph Co.
Kellogg Switchboard
Rubicon Co.
Shallcross Mfg. Co.
Sherron Metallic
Technology Instrument

(Continued)

EMERY PRODUCTS

SERVE A WIDE RANGE OF FORCE-MEASUREMENT & TESTING REQUIREMENTS & APPLICATIONS

PRODUCTS

DYNAMOMETERS
DYNAMOMETER SCALES
BOURDON GAUGES
PRESSURE TEMPERATURE COMPENSATED GAUGES
PRECISION PRESSURE GAUGES
HYDRAULIC LOAD CELLS—COMPRESSION & TENSION
PNEUMATIC LOAD CELLS—COMPRESSION & TENSION
HYDRAULIC JACKS
HYDRAULIC VALVES
CABLE TENSION TESTERS
INDICATORS
RECORDERS
REMOTE INDICATING AND PRINTING APPARATUS
TORSION METERS
TORQUE METERS
TOWING DYNAMOMETERS
TRACTION DYNAMOMETERS
HYDRAULIC SCALES
CRANE SCALES
TESTING MACHINES

USES

The variety of uses of force-measuring equipment is almost limitless. Some of the many important applications of EMERY products are for:

DYNAMOMETER MEASUREMENTS
WIND TUNNEL BALANCES
STRENGTH OF STRUCTURES
MEASUREMENT OF JET ENGINE THRUST
TORQUE MEASUREMENTS
STRENGTH OF MATERIALS
ROCKET THRUST
INDUSTRIAL WEIGHING
BRAKE TESTING
CABLE, CHAIN AND ROPE TESTING
PORTABLE WEIGHING SYSTEMS

and other special force measurement problems

The EMERY HYDRAULIC CELL

is the heart of many diverse force-measuring systems and equipment, used by important industries, government and research organizations for over 75 years.

Force exerted on the loading platform of the cell is converted into proportional hydraulic pressure; this pressure may be transmitted to a wide variety of indicators, recorders or other pressure sensitive apparatus depending on the application. The Emery cell is rugged in construction, leakproof, requires no maintenance, frictionless, and may be installed in any position without careful alignment. Sensitivity and stability of action give excellent duplication of test results. The Emery cell can accommodate substantial cross loading or non-central loading without measurable loss in accuracy or sensitivity. Inherently stable. less than .005" deflection under full load. High natural frequency. Withstands heavy vibration or shock loading; no external dampeners or stabilizers needed. Emery cells are available in standard units up to 100,000 lb. capacity; higher capacities on special order.

THE A. H. EMERY CO. 75 YEARS HYDRAULIC WEIGHING

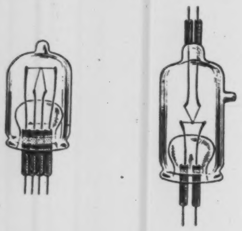
THE A. H. EMERY CO.

PINE STREET NEW CANAAN, CONN.

Vacuum . . .
Thermocouples

86 Standard Types
and Ranges

Including a complete line for measurements at ultra-high frequencies.



- DEPENDABLE STABILITY
- HIGHER OVERLOAD
- FASTER RESPONSE
- LOWER COST
- PROMPT DELIVERY

*For complete data send
for our Catalog No. 86A*

AMERICAN
THERMO-ELECTRIC CO.
67 E. 8th Street New York 3, N.Y.

**TESTING SETS, Water**
Barnstead Still
Burrell Technical Supply
Gerin Corp.
Hagan Corp.
Hellige, Inc.
Industrial Inst., Inc.
Scientific Glass App.
Taylor & Co., W. A.

**TESTING SIEVE SHAKER (See Sieve Shakers)**

**TESTING SIEVES (See Sieves, Testing)**

**THEODOLITES (See Surveying Instruments)**

**THEODOLITES, Magnetic**
Gurley, W. & L. E.
Ruska Inst. Corp.

**THEODOLITES, Pilot Balloon**
White Co., Inc., David

**THERMIONIC RECTIFIERS (See Rectifiers, Thermionic)**

**THERMO-AMMETERS (See Ammeters, Thermo)**

**THERMOCOUPLE EXTENSION LEAD WIRE**
Bristol Co.
Electro-Tech Equipment
Engelhard, Inc., Chas.
Illinois Testing Labs.
Leeds & Northrup
Precision Tube Co.
Pyrometer Instrument Co.
Revere Corp.
Richards Co., A. S.
Tagliabue Div.
Thermo Electric Co.

**THERMOCOUPLE WELLS (See Tubes, Pyrometer)**

**THERMOCOUPLE WIRE**
Baker & Co.
Bristol Co.
Electro-Tech Equipment
Engelhard, Inc., Chas.
Illinois Testing Labs.
Leeds & Northrup
Pyrometer Instrument Co.
Revere Corp.
Richards Co., A. S.
Tagliabue Div.
Thermo Electric Co.

**THERMOCOUPLES, Base Metal**
Airflo Instrument Co.
Assembly Products
Bailey Meter Co.
Bacharach Industrial Inst.
Bristol Co.
Burlington Inst. Co.
Campbell Co., J. A.

(Continued)

Cole Instrument
De Jur-Amsco
Elematic Equip. Corp.
Engelhard, Chas.
Fillo Sls. & Engr. Co.
Foxboro Co.
General Controls
General Elec. Co.
Gordon Co., Claud S.
Gordon Machine & Tool
Ill. Testing Labs.
Industrol Corp.
J-B-T Insts. Inc.
Leeds & Northrup
Lewis Engg. Co.
Loudon Insts.
Marshall Co., L. H.
Meters, Inc .
Minneapolis-Honeywell
Pyrometer Instrument
Pyrometer Service Co.
Revere Corp.
Thermo-Elec. Co.
Richards Co., Inc., Arklay
Thermo-Elec. Co.
Taco West Corp.
Tagliabue Div.
Taylor Inst. Cos.
Thermo Electric Co.
Thwing-Albert Instrument
Westinghouse Elec.
Wheelco Inst. Co.
Winslow Co.

**THERMOCOUPLES, Contact Type**
Amer. Thermo-Elec.
Bailey Meter Co.
Bristol Co.
Cambridge Inst. Co.
Campbell Co., J. A.
Cannon Electric
Cole Instrument
De Jur-Amsco
Elematic Equip. Corp.
Engelhard, Charles
Fillo Sls. & Engr. Co.
General Controls Co.
General Electric
Gordon Co., Claud S.
Hickok Elec. Inst. Co.
Ill. Testing Labs.
J-B-T Instruments
Lewis Engg. Co.
Phen-Trols, Inc.
Precision Tube Co.
Pyrometer Instrument
Pyrometer Service Co.
Revere Corp.
Rowe Engineering
Sensitive Research Inst.
Taco West Corp.
Tagliabue Div.
Thermo Electric Co.
Thwing-Albert Instrument
Wheelco Inst. Co.
Winslow Co.

**THERMOCOUPLES, Rare-metal (See Base Metal above)**

**THERMOCOUPLES, Separate Heater Type**
Amer. Thermo-Elec.
Beam Instrument
Campell Co., J. A.
Cole Instrument
Electro-Tech Equip. Co.
General Controls
General Elec. Co.
General Radio Co.
Illinois Testing Labs.
Sensitive Research Inst.
Taco West Corp.
Wheelco Insts. Co.

**THERMOCOUPLES, Vacuum**
Amer. Thermo-Elec.
Beam Instrument
Beckman Instruments
Biddle Co., James G.
Cambridge Inst. Co.
Cole Instrument
Distillation Products
Farrand Optical
Fredericks Co., George
Field Electric
General Elec. Co.
General Radio Co.
Hastings Instrument
Hickok Elec. Inst. Co.
National Research
Perkins Elmer Corp.
Phen-Trols, Inc.
Pyrometer Instrument
Rawson Elec. Inst. Co.
Reeder & Co., Charles
Sensitive Research Inst.
Universal X-Ray Prods.
Wheelco Inst. Co.

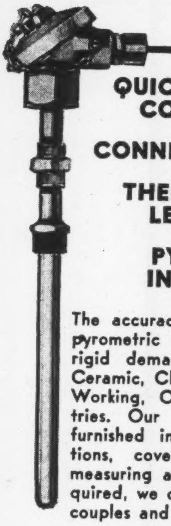
**THERMO-HYDROMETERS (See Hydrometers, Indicating)**

**THERMOMETER TESTERS (See Testers, Thermometer)**

**THERMOMETER TEST WELLS**
Campbell Co., J. A.
Equipoise Controls
Freas Glass Works
General Electric
G. M. Mfg. Co.
Gordon Machine & Tool
Gotham Inst. Co.
H-B Instrument
Hiergesell & Sons
Industrol Corp.
Jerguson Gage & Valve
Kahl Sci. Inst. Co.
Manning, Maxwell & Moore
Moeller Inst. Co.
Nurnberg Thermometers
Palmer Thermometers
Precision Thermometer
Refinery Supply
Scientific Instrument

(Continued)

Thermo-COUPLES
STANDARD OR SPECIAL



QUICK COUPLING CONNECTORS
•
CONNECTOR PANELS
•
THERMOCOUPLE LEAD WIRES
•
PYROMETER INDICATORS
•

The accuracy and quality of our pyrometric equipment meets the rigid demands of the Aircraft, Ceramic, Chemical, Glass, Metal-Working, Oil and Plastic Industries. Our standard equipment, furnished in all regular calibrations, cover most temperature measuring applications. When required, we design special thermocouples and accessories.

***Standard Thermocouple Equipment can be selected easily from our Catalog F. Send for your copy now.***

Thermo Electric Co., Inc.
FAIR LAWN NEW JERSEY

Tagliabue Div.
Taylor Inst. Cos.
Thwing-Albert Inst. Co.
Trerice Co.
Trinity Equipment
Turner Electric Co.
Weksler Thermometer

**THERMOMETERS, Indicating, Electrical Resistance**
Am. Temperature Ind.
Assembly Products
Bailey Meter Co.
Bristol Co.
Cole Instrument
De Jur-Amsco Corp.
Edison Inc., Thomas A.
Electric Auto-Lite
Engelhard, Chas.
Foxboro Co.
Friez Instrument Div.
General Controls
General Elec. Co.
Gordon Co., Claud S.
Gow-Mac Instrument
G-M Labs.
Gray Instrument
Hays Corp.
Hickok Elec. Inst.
Ill. Testing Labs
J-B-T Insts. Inc.
Kahl Scientific Inst.
Leeds & Northrup Co.
Lewis Engineering
Manning, Maxwell & Moore
Minneapolis-Honeywell
Perfex Corp.
Roller-Smith Co.
Rubicon Co.
Shallcross Mfg. Co.
Stewart, M. C.
Taco West Corp.
Tagliabue Div.
Thwing-Albert Instrument
Trans-Sonics, Inc.
Trerice Co.
Triplett Elec. Inst.
Weiler, Paul G.
Wheelco Inst. Co.
Weston Elec. Inst. Corp.
Winslow Co.

**THERMOMETERS, Indicating, Mechanical**
American Temp. Ind.
Bacharach Ind. Inst.
Bailey Meter Co.
Bristol Co.
Defender Insts. & Reg.
Dickson Co.
Dillon & Co.
Electric Auto-Lite Co.
Equipoise Controls
Foxboro Co.
Friez Instrument

(Continued)

G-M Mfg. Co., Inc.
Gotham Inst.
H-B Instrument
Hiergesell & Sons
Illinois Testing Labs.
Kollsman Inst. Co.
Manning, Maxwell & Moore
Marsh Corp.
Minneapolis-Honeywell
Moeller Inst. Co.
Nurnberg Thermometer
Palmer Thermometers
Partlow Corp.
Phila. Thermometer Co.
Powers Regulator
Precision Thermometer
Preferred Utilities
Refinery Supply
Republic Flow Meters
Rochester Mfg. Co.
Sarco Co., Inc.
Scientific Inst. Co.
Serdex, Inc.
Standard Thermometer
Tagliabue Div.
Taylor Inst. Cos.
Thwing-Albert Inst. Co.
Trerice Co.
U. S. Gage Co.
Viking Instruments
Wagner & Son
Weksler Thermometer
Weston Elec. Inst. Corp.

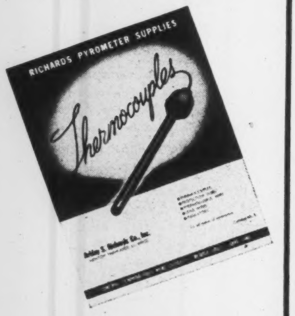
**THERMOMETERS, Indicating, Mercury-in-Glass, Industrial & Laboratory**
Ace Glass, Inc.
Accurate Inst. Co.
Accuracy Scientific Inst.
Bacharach Ind. Inst.
Bristol Co.
Consol. Ashcroft Hancock
Dillon & Co.
Electric Auto-Lite Co.
Electric Hotpack Co.
Ever Ready Thermometer
Fish-Schurman Co.
Flieschhauer & Son
Freas Glass Works
Friez Instrument Div.
G. M. Mfg. Co., Inc.
Goetz Niemer Co.
Gotham Inst. Co.
Green, Henry J.
Griebel Co.
H-B- Instrument
Hiergesell & Sons
Johnson Service Co.
Kahl Scientific Inst.
Kessler Co.
Kimble Glass Co.
Manning, Maxwell & Moore
Microchemical Service
Miller & Weber
Moeller Instrument Co.
Nurnberg Thermometer

(Continued)

Control Temperatures More Closely
*REDUCE COST • SAVE TIME*

This CATALOG
of
IMPROVED
PYROMETER
SUPPLIES
shows you how!

*Get your FREE COPY
TODAY!*



★ THERMOCOUPLES ★ PROTECTION TUBES
★ THERMOCOUPLE Wire ★ LEAD WIRE
★ INSULATORS ★ TERMINAL HEADS

***Please send free copy of Catalog No. 5.***

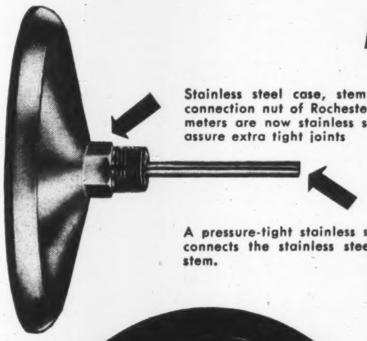
*Name* ______________ *Title* ______
*Company* ______________
*Street* ______________
*City* ______________ *State* ______

ARKLAY S. RICHARDS CO., Inc.
NEWTON HIGHLANDS 61, MASS.

# *Rochester* Announces

# AN ALL STAINLESS STEEL INDUSTRIAL THERMOMETER

## More durable . . . more pressure-tight . . . more resistant to corrosion



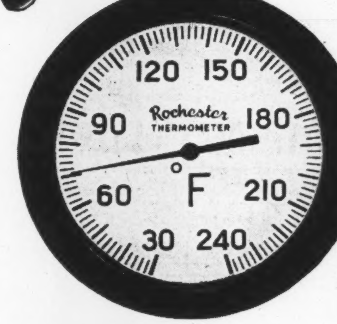
Stainless steel case, stem, bushing and connection nut of Rochester Dial Thermometers are now stainless steel *welded* to assure extra tight joints

A pressure-tight stainless steel weld also connects the stainless steel plug to the stem.

Here is a dial thermometer designed especially for heavy-duty petroleum and chemical processing service.

Rochester's new process for welding stainless steel makes it possible to offer you an industrial thermometer that is more pressure-tight than ever before. More resistant to corrosion, too, because the use of silver solder has been completely eliminated.

Welded at the connection nut joining the case and stem and at the plug end of the stem, all exposed parts are made of high quality stainless steel for longer durability.



**TEMPERATURE RANGES**

| FAHRENHEIT | | CENTIGRADE | DUAL SCALE |
|---|---|---|---|
| -50 to 120° F. | 50 to 350° F. | -70 to 160° C. | -90 to 130° F. |
| -70 to 150° F. | 0 to 500° F. | -10 to 110° C. | 70 to 56° C. |
| 0 to 200° F. | 150 to 750° F. | 0 to 150° C. | |
| 0 to 300° F. | *200 to 1000° F. | 0 to 300° C. | |
| 30 to 240° F. | ................. | 100 to 400° C. | |

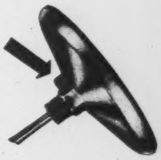
*Not recommended for continuous operation above 800° F.

### OTHER ADVANTAGES

A new precision bi-metallic element assures high sensitivity—quick reaction to temperature changes. It is free from pointer vibration and highly accurate—even under extreme temperature variations.

Rochester Thermometers have large dials with big, bold characters that enable you to take readings easily . . . *at a glance.* There's no squinting at hard-to-see mercury columns.

### CONVENIENT RECALIBRATION FEATURE



To assure permanent accuracy, Rochester Dial Thermometers are available with a screw adjustment that permits easy recalibration—right on the job. You just put the instrument in boiling water or other known temperature and reset the indicator.

This unique feature compensates for abuse and accidents . . . like dropping or banging a thermometer sufficiently hard to make readings inaccurate . . . which could result in costly production errors.

**ROCHESTER MANUFACTURING CO., INC., 73 ROCKWOOD STREET, ROCHESTER 10, N. Y.**

**Rochester Industrial Thermometer Representatives**
**TORONTO, ONTARIO, CANADA,** F. C. Baker and Company, 229 Yonge Street; **ST. LOUIS 3, MISSOURI,** MacGregor-Sears Company, 108 North 18th Street; **CHARLOTTE 1, NORTH CAROLINA,** Mec-Tric Control Company, P. O. Box 354; **DETROIT 2, MICHIGAN,** Metrol Company, 5538 Cass Avenue; **SHREVEPORT 88, LOUISIANA,** Paul E. Rogers, P. O. Box 967, 266 Patton Avenue; **SAN FRANCISCO 3, CALIFORNIA,** Gordon Bennett, G. R. Schumann Company, 1355 Market Street; **PORTLAND, OREGON,** J. C. Ball, G. R. Schumann Company, Terminal Sales Building; **LOS ANGELES 14, CALIFORNIA,** G. S. Feldman, G. R. Schumann Company, 712 S. Olive Street; **TULSA, OKLAHOMA,** Snyder and Company, Inc., 1432 East 6th Street; **KANSAS CITY 6, MISSOURI,** Mark E. Carter, Snyder and Company, Inc., Room 615-Pickwick Building, 903 McGee Street; **WICHITA, KANSAS,** R. N. Short, Snyder and Company, Inc., P. O. Box 2836, South Wichita Station; **CLEVELAND 13, OHIO,** Ralph M. Nelson, 712 Marshall Building; **ODESSA, TEXAS,** Industrial Corporation, P. O. Box 1909; **HOUSTON, TEXAS,** Brance Krachy Company, Inc., 118 Staples; **BOSTON 18, MASSACHUSETTS,** G. K. Kerisher, 108 East Dedham Street; **SYRACUSE 6, NEW YORK,** George O. Miller, 441 Ridgewood Drive; **PHILADELPHIA 3, PENNSYLVANIA,** William Diament, Devic Engineering, 1701 Walnut Street; **NEW YORK, NEW YORK,** Energy Control Company, Inc., 5 Beekman Street.

**ROCHESTER**
**MANUFACTURING COMPANY, INC.**
**DIAL THERMOMETERS GAUGES AMMETERS**

ROCHESTER GAUGES
DEPENDABLE ACCURACY

***Rochester Thermometers are backed by more than 35 years experience in making dependable automotive and industrial instruments.***

POWERS

ACCURATE
THE POWERS DIAL THERMOMETER
FAHRENHEIT
THE POWERS REGULATOR CO. CHICAGO NEW YORK
EASY To READ At a Distance
DEPENDABLE
Variety of Ranges

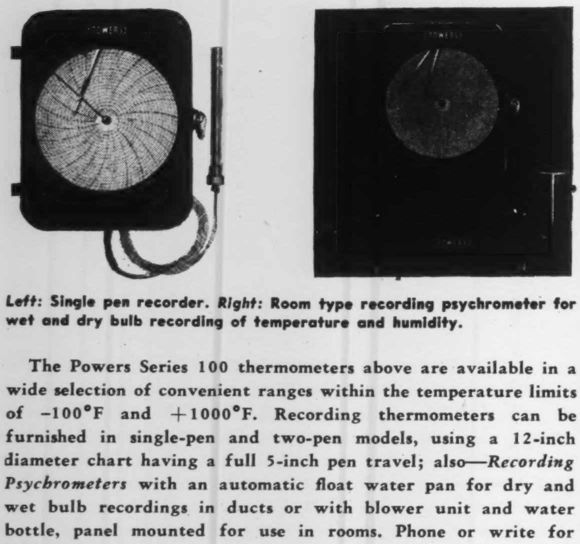
••••••••••••DIAL THERMOMETERS••••••••••••

*Help Cut Costs —*

For more accurate temperature readings and improved efficiency use POWERS Dial Thermometers. They're vapor pressure actuated. Have 4" dials with either rigid stem for use in pipe lines and tanks or flexible tubing type for conveniently showing the temperature at a remote point.

*Phone or write nearest office for Bulletin 355.*

RECORDING THERMOMETERS



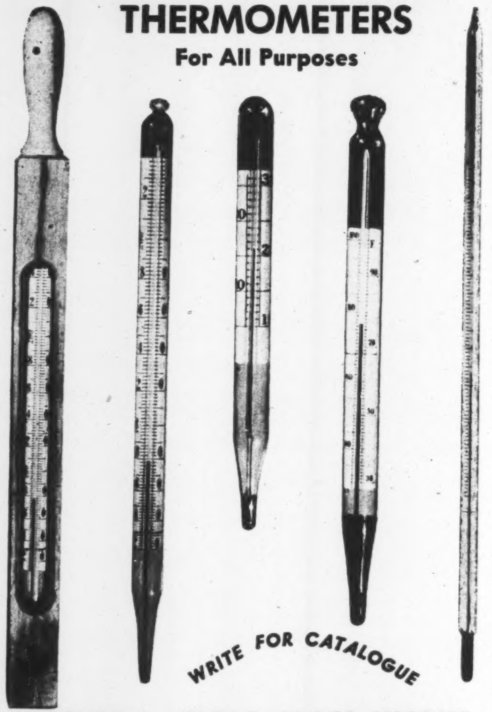
***Left:* Single pen recorder. *Right:* Room type recording psychrometer for wet and dry bulb recording of temperature and humidity.**

The Powers Series 100 thermometers above are available in a wide selection of convenient ranges within the temperature limits of −100°F and +1000°F. Recording thermometers can be furnished in single-pen and two-pen models, using a 12-inch diameter chart having a full 5-inch pen travel; also—*Recording Psychrometers* with an automatic float water pan for dry and wet bulb recordings in ducts or with blower unit and water bottle, panel mounted for use in rooms. Phone or write for Bulletin 370.

COMPLETE LINE OF TEMPERATURE INDICATING and RECORDING CONTROLLERS

Simple self-operated indicating regulators, also air operated indicating and recording controllers. Phone or write nearest office for bulletins.

THE POWERS REGULATOR COMPANY
Address: 3434D Oakton Street, Skokie, Illinois
Established 1891 • Offices Over 50 Cities • See Your Phone Book

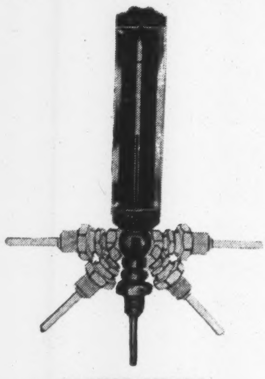


THERMOMETERS
For All Purposes

WRITE FOR CATALOGUE

FRANCIS L. FREAS GLASS WORKS
*Manufacturers of Better Instruments since 1905*
CONSHOHOCKEN, PA.

180° SWING • FRONT TO BACK • LEFT TO RIGHT
versatility



ADJUST-ANGLE INDUSTRIAL THERMOMETERS

U. S. Pat. No. 25,254,894
Can. Pat. No. 470,606
U.K. Pat. No. 637,077

Simplifies maintenance, reduces replacement stock, easy installation. Supplied with interchangeable socket or other fittings. 7", 9" or 12" case. 3½" to 30" stem. One of a complete range of Weksler instruments for measuring and recording Temperature, Pressure or Humidity.

*Write for Catalog*

WEKSLER THERMOMETER CORP.
52-56 West Houston Street, New York 12, N. Y.

Palmer Thermometers
Paulstich & Sons
Phila. Thermometer
Phoenix Prec. Inst.
Precision Scientific Co.
Precision Thermometer
Rascher & Betzold
Refinery Supply
Rieker Instrument Co.
Ruehfel Co.
Scientific Glass App.
Scientific Inst. Co.
Seedburo Equipment
Seely Instrument Co., Inc.
Tagliabue Div.
Taylor Inst. Cos.
Trerice Co.
U. S. Gauge
Wagner & Son
Weksler Thermometer

**THERMOMETERS, Indicating, Pressure-spring**

Bailey Meter Co.
Bristol Co.
Dickson Co.
Electric Auto-Lite Co.
Foxboro Co.
Gotham Instrument
Liquidometer Co., Inc.
Manning,Maxwell & Moore
Marshalltown Mfg.
Marsh Corp., Jas. P.
Mason-Nielan Regulator
Minneapolis-Honeywell
Moeller Instrument Co.
Moore Products
Nurnberg Thermometer
Palmer Thermometers
Partlow Corp.
Powers Regulator Co.
Preferred Utilities Mfg.
Republic Flow Meters
Rochester Mfg. Co.
Scientific Inst. Co.
Standard Thermometer
Tagliabue Div.
Taylor Inst. Cos
Trerice Co
United States Gauge
Weksler Thermometer
Wheelco Instruments
Welch Scientific

**THERMOMETERS, Indicating, Spirit-in-Glass**

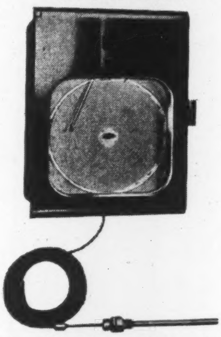
Accurate Inst. Co.
Accuracy Sci. Inst.
Ever Ready Thermometer
Fleischauer & Son
Freas Glass Works
Friez Instrument Div.
G. M. Mfg. Co.
Gotham Inst. Co.
Green, Henry J.
Greibel Co.

(Continued)

**BRISTOL SERIES 500**

**RECORDING THERMOMETERS**

**—125°F to 1000°F**



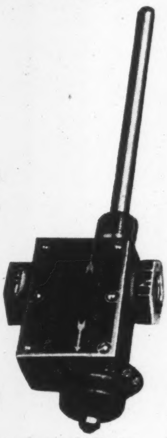
Bristol Series 500 Thermometers include the latest improvements in instrument design. Incorporating many exclusive features, they are engineered and built on a solid foundation of over half-a-century of experience.
In manufacturing hundreds of thousands of recording thermometers, The Bristol Company has developed a variety of models, sizes, and temperature ranges to fill every modern industrial requirement.
Ask for Bulletin T840 which describes our complete line of thermometers.

**THE BRISTOL COMPANY**
**113 BRISTOL RD., WATERBURY 20, CONN.**

*Superior*
**Industrial**
**THERMOSTATS**
**for Gas and Oil Burners**

***8 Important Advantages***

- **Convenient Adjustment**
- **Easy to Install**
- **No stuffing boxes**
- **Durable Construction**
- **Compact Design**
- **Compound Lever Action**
- **Saves Fuel**
- **Instantaneous Throttling Control**



**Available in sizes from ¼" to 1½". Has calibrated dial.**
***Also***
***Steam Pressure Controls***
***for Gas Fired Boilers***
***Write for literature***

**Superior Controls Co., Inc.**
**1835 Bonnie Brae,**
**Los Angeles 6, Calif.**

H-B Instrument
Hiergesell & Sons
Huddleston, J. S. F.
Johnson Service Co.
Kahl Scientific Inst.
Kessler Co.
Kimble Glass Co.
King Engineering
Manning, Maxwell & Moore
Minneapolis-Honeywell
Miller & Weber
Moeller Instrument Co.
Nurnberg Thermometer Co.
Palmer Thermometers
Philadelphia Thermometer
Precision Therm. & Inst.
Ruttco Mfg. Co.
Scientific Instrument Co.
Scientific Glass App.
Seely Instrument Co.
Tagliabue Div.
Taylor Instrument Cos.
Testrite Instrument
Trerice Co., H. O.
Weksler Thermometer

**THERMOMETERS, Maximum & Minimum Registering**

Accuracy Scientific
Electric Auto-Lite Co.
Fleischhauer & Son
Foxboro Co.
Friez Instrument
G. M. Mfg. Co.
Gotham Inst. Co.
Green, Henry J.
H-B Instrument
Kahl Scientific Inst.
Kessler Co., Walter
Hiergesell & Sons
Lewis Engineering
Manning, Maxwell & Moore
Moeller Instrument Co.
Nurnberg Thermometer Co.
Palmer Thermometers
Philadelphia Thermometer
Precision Thermometer
Rieker Instrument Co.
Scientific Instrument Co.
Seedburo Equipment
Tagliabue Div.
Taylor Inst. Cos.
Trerice Co., H. O.
Wagner & Son
Weksler Thermometer
Weston Elec. Inst. Corp.

**THERMOMETERS, Portable**

Bacharach Ind. Inst.
Bristol Co.
Consol. Ashcroft Hancock
Dickson Co.
Electric Auto-Lite Co.
Engelhard, Chas.
Equipose Controls
Foxboro Co.
Friez Instrument
Gotham Inst. Co.
Green, Henry J.
H-B Instrument
Hiergesell & Sons
Illinois Testing Labs.
Kahl Scientific Inst.
Lewis Engineering
Manning, Maxwell & Moore
Marsh Corp.
Mason-Neilan Regulator
Moeller Inst. Co.
Nurnberg Thermometer
Palmer Thermometers
Penn Ind. Inst. Corp.
Powers Regulator Co.
Precision Thermometer
Scientific Inst. Co.
Tagliabue Div.
Taylor Inst. Cos.
Testrite Inst. Co.
Trerice Co.
U. S. Gauge
Wagner & Son
Weksler Thermometer
Weston Elec. Inst. Corp.

**THERMOMETERS, Recording and/or Controlling, Electrical Resistance**

Assembly Products
Bailey Meter Co.
Bristol Co.
Cambridge Inst. Co.
Cole Instrument
Defender Insts. & Reg.
De Jur-Amsco Corp.
Electric Auto-Lite
Engelhard, Chas.
Foxboro Co.
General Elec. Co.
Gordon Co., Claud S.
Green, Henry J.
Ill. Testing Labs.
Kahl Scientific Inst.
Leeds & Northrup Co.
Loudon Insts.
Manning, Maxwell & Moore
Mason-Neilan
Minneapolis-Honeywell
Moeller Inst. Co.
Scientific Instrument
Tagliabue Div.
Thwing-Albert Instrument
Trerice Co.
Wagner & Son
Weksler Thermometer
Wheelco Insts. Co.

**THERMOMETERS, Recording and/or Controlling, Mechanical**

Bacharach Ind. Inst.
Bailey Meter Co.
Bristol Co.
Defender Inst. & Reg.
Dickson Co.
Electric Auto-Lite Co.
Elematic Sales Corp.
Foxboro Co.
Friez Instrument

(Continued)

**PROMPT REPAIR SERVICE ON ALL MAKES**

•

**Let our experienced staff assist you with any problem arising in our field**

•

**Send for Catalog**

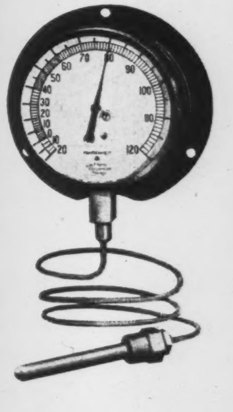
**THERMOMETERS**
and
**THERMOSTATS**
for
**RESEARCH**
and
**INDUSTRY**

A complete line with a wide selection of ranges and sizes. Extra quality grade to meet requirements of the Bureau of Standards and other specifications as A.S.T.M. and M.C.A.

**THE PHILADELPHIA THERMOMETER CO.**
**SIXTH & CAYUGA STREETS, PHILADELPHIA 40, PA.**

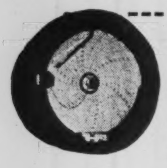
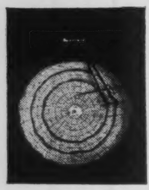
**MARSH DIAL THERMOMETERS**

The same basic refinements that distinguish Marsh Pressure Gauges are found in Marsh Dial Thermometers. Bourdon tube types are available in self contained and distant reading instruments. They are available in both gas filled and vapor-tension types. All temperature ranges up to 400° F are included in the broad Marsh line. The Marsh "Recalibrator," quickest and best method of correcting a thermometer that has been knocked out of adjustment, is standard in all bourdon tube types.



Ask for details covering your specific service ranges and operating conditions.

**JAS. P. MARSH CORPORATION**
**Dept. 8, Skokie, Ill.**



**THERMOMETERS...*For Indicating, Recording and Controlling Temperatures Up to 1000°F.***

**CIRCULAR CASE:** Recorders have 8" dia. charts with a calibrated width of 3"; Indicators have 6" calibrated scale; Controllers have variety of switching actions for numerous applications. Write for Catalog 6481-8.

**RECTANGULAR CASE:** Furnished with 12" dia. charts and calibrated width of 4⅝"; Indicators have a 7½" eccentric scale. Available with vapor, gas or mercury filled thermal systems. Both recorders and indicators have variety of pneumatic and electric control forms, including famous *Air-O-Line* and *Electr-O-Vane* types. Write for Catalogs 8905 and 6002. MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4579 Wayne Ave., Phila. 44, Pa.

MINNEAPOLIS
**Honeywell**
Brown Instruments

Giannini & Co., G. M.
Gotham Inst. Co.
Green, Henry J.
H-B Instrument
H & H Thermostats
Manning, Maxwell & Moore
Marsh Corp.
Mason-Neilan Regulator
Minneapolis-Honeywell
Moeller Instrument Co.
Nurnberg Thermometer
Palmer Thermometer
Partlow Corp.
Penn Ind. Inst. Corp.
Powers Regulator
Republic Flow Meters
Scientific Instrument
Serdex, Inc.
Standard Thermometer
Tagliabue Div.
Taylor Inst. Co.
Weksler Thermometer

**THERMOMETERS, Recording and/or Controlling, Mercury-actuated**

Alden Products
Green, Henry J.
H-B Instrument
Manning, Maxwell & Moore

(Continued)

Minneapolis-Honeywell
Palmer Thermometers
Partlow Corp.
Refining Supply Co.
Tagliabue Div.
Taylor Instrument Cos.
U. S. Gauge Co.

**THERMOMETERS, Recording and/or Controlling, Pressure-Spring**

Bailey Meter Co.
Bristol Co.
Defender Inst. & Reg.
Dickson Co.
Electric Auto-Lite Co.
Foxboro Co.
Gotham Inst. Co.
Liquidometer Co.
Manning, Maxwell & Moore
Marsh Corp.
Mason-Neilan Regulator
Minneapolis-Honeywell
Moeller Instrument Co.
Moore Products
Palmer Thermometer
Partlow Corp.
Penn Ind. Inst. Corp.
Powers Regulator Co.
Preferred Utilities Mfg.

(Continued)

Republic Flow Meters
Scientific Inst. Co.
Tagliabue Div.
Tayler Inst. Cos.
Trerice Co.
Wagner & Son
Weksler Thermometer
Wheelco Instruments

**THERMOPILES**

Baird Associates
Biddle Co., James G.
Cambridge Inst. Co.
Eppley Lab.
Gaertner Scientific Corp.
Gordon Co., Claud S.
Hastings Instruments
Illinois Testing Labs.
Jarrell-Ash Co.
Leeds & Northrup Co.
Rawson Electric Inst.
Reeder & Co., Charles M.
Revere Corp.
Thermo-Elec. Co.

**THERMOREGULATORS, Bimetallic**

American Instrument
Kauffman-Lattimer
Valverde Labs.

**THERMOREGULATORS, Mercury-in-Glass**

Accuracy Scientific Inst.
Aloe Co., A. S.
Central Scientific
Electric Hotpack Co.
Fish-Schurman Corp.
Fisher Scientific Co.
Friez Instrument
Green, Henry J.
H-B Instrument
Kessler Co., Walter
Moeller Instrument Co.
Philadelphia Thermometer
Precision Scientific Co.
Precision Thermometer
Process & Instruments
Sargent & Co., E. H.
Scientific Glass App.
Tagliabue Div.
Taylor Instrument Cos.
Weksler Thermometer

**THERMOSTATS**

Accuracy Scientific Inst.
Acro Switch Div.
Allen-Bradley Co.
American Inst. Co.
Automatic Products Co.
Barber-Colman

(Continued)

Brabender Corp.
Bridgeport Thermostat
Burling Inst. Co.
Control Products, Inc.
Cook Electric
Dickson Co.
Edison Inc., Thomas
Electric Hotpack Co.
Elematic Sales Corp.
Electro-Tech Equip. Co.
Emerson Apparatus Co.
Farris Stacon
Fenwal, Inc.
Fish-Schurman Co.
Fulton Sylphon Div.
General Electric Co.
Gleason-Avery
G-V Controls
Hawk Tool Eng. Co.
H-B Instrument
Klipfel Mfg. Co.
Mechanical Industries
Mercold Corp.
Minneapolis-Hineywell
Partlow Corp.
Penn Electric Switch
Perfex Corp.
Philadelphia Thermometer
Powers Regulator Co.
Precision Scientific Co.
Precision Therm. & Inst.
Preferred Utilities
Premier Crystal Labs.
Rascher & Betzold
Sampsel Time Control
Scientific Glass App.
Smith Control & Inst.
Standard Therm., Inc.
Superior Controls
Tagliabue Div.
Tenney Engineering
Trerice Co.
Ulanet Co.
United Elec. Controls
Valverde Labs.
Wilcolator Co.

**THERMOSTATIC METALS (See Metals, Thermostatic)**

**THERMO-VOLTMETERS (See Voltmeters, Thermo)**

**THERMOWELLS (See Thermometer Test Wells)**

**THICKNESS GAGES (See Gages, Thickness)**

**THREAD MEASURING WIRES (See Wires, Thread Measuring)**

**TIDE GAGES**

American Inst. Co.
Foxboro Co.
Gurley, W. & L. E.
Leupold & Stevens
Parks Co., Harry S.
Uehling Inst. Co.

**TIME, Controllers (See Controllers, Automatic, Time)**

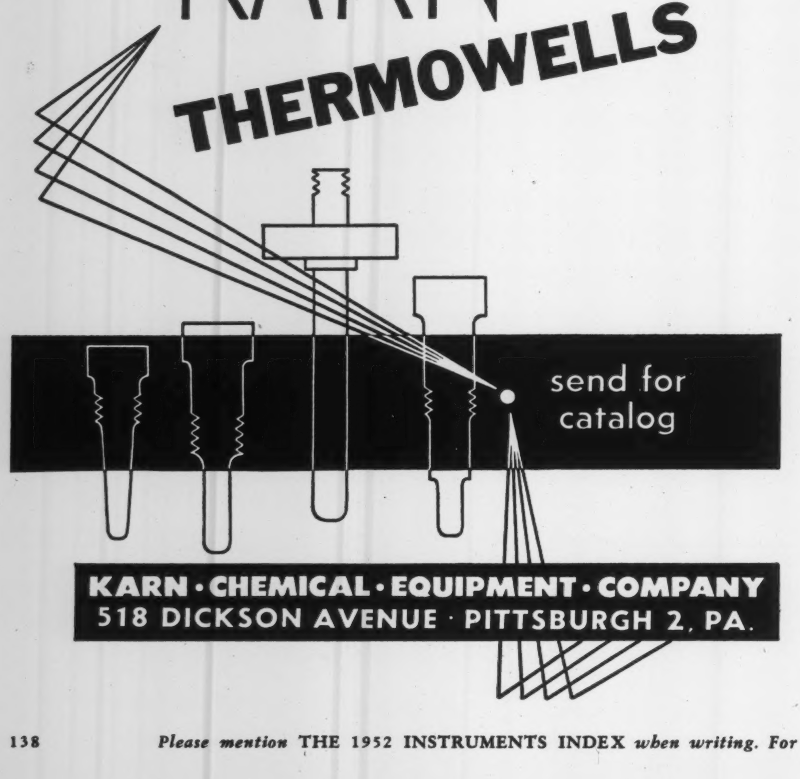
**TIME Indicators**

Aero Instrument
Alina Corp.
Amer. Chronoscope
Automatic Elec. Chicago
Automatic Temp. Control
Bristol Co.
Century Geophysical
Cincinnati Time Rec.
Cook Electric
Cramer Co., R. W.
Crystal Research Labs.
Cyclotron Specialties
Dimco-Gray Co.
Eclipse-Pioneer Div.
Electric Tachometer
Elgin National Watch
Foxboro Co.
Gaertner Scientific Corp.
General Elec. Co.
Gotham Inst. Co.
Haydon Co., A. W.
Haydon Mfg. Co.
Industrial Timer
International Bus. Mach.
Jaeger Watch Co.
J-B-T Instruments
National Time & Signal
Potter Instrument
Precision Scientific Co.
Rawson Electrical Inst.
Seely Inst. Co.
Serdex, Inc.
Standard Elec. Time
Stoelting Co., C. H.
Stromberg Time Corp.
Tagliabue Div.
Telechron Inc.
Thompson Clock Co.
Westinghouse Elec.
Weston Elec. Inst.

**TIME, Recorders**

Abrams Instrument
Aero Instrument
Alina Corp.
American Time Prod.
Automatic Elec. Chicago
Automatic Temp. Control
Bristol Co.
Calculagraph Co.
Century Geophyscial
Cincinnati Time Rec.
Clebar Watch Co.
Cole Instrument
Cramer & Co., Inc.
Cyclotron Specialties
Dorothea Mechanisms, Gale
Ducommun Co.
Electric Tachometer
Electro-Tech Equip. Co.
Esterline-Angus Co.

(Continued)


KARN
THERMOWELLS

send for catalog

KARN · CHEMICAL · EQUIPMENT · COMPANY
518 DICKSON AVENUE · PITTSBURGH 2, PA.

TURNER
THERMOWELLS

Machined from bar stock
Prompt deliveries
Descriptive Bulletin sent on request

E. W. TURNER ELECTRIC CO.
6138-40 N. BEECHWOOD ST.
P.O. BOX 6564
PHILADELPHIA 38, PA.

Foxboro Co.
Fries Instrument
Gaertner Scientific Corp.
General Elec. Co.
Gorrell & Gorrell
Gotham Inst. Co.
Haydon Co., A. W.
Haydon Mfg. Co.
Hathaway Instrument
International Bus. Mach.
Jaeger Watch Co.
Knopf Instrument
Martin-Hubbard Corp.
Potter Instrument
Scientific Inst. Co.
Service Recorder Co.
Simplex Time Recorder
Stromberg Time Corp.
Tagliabue Div.

### TIME INTERVAL APPARATUS

Abrams Instrument
Aero Instrument
Amer. Chronoscope
Am. Gas Accumulator
Automatic Elec. Chicago
Automatic Elec. Mfg.
Automatic Temp. Control
Barber-Colman
Berkeley Scientific
Betts & Betts
Bristol Co.
Browning Laboratories
Builders-Providence
Cincinnati Time Rec.
Coleman Elec. Co.
Cramer Co., Inc.
Crystal Research Labs.
Dimco-Gray Co.
Dorothea Mechanisms, Gale
Electric Tachometer
Electro-Physics Co.
Electronic Control
Esterline-Angus
Fredericks Co., Geo.
Gaertner Scientific
General Electric Co.
General Electric X-Ray
Gorrell & Gorrell
Guardian Elec. Mfg. Co.
Hathaway Instrument
Haydon Co., A. W.
Industrial Timer Corp.
Leeds & Northrup
Lektra Labs.
Lumenite Electronic
Martin-Hubbard Corp.
National Time & Signal
Nelson & Street
Paragon Electric Co.
Perfex Corp.
Phipps & Bird
Photoswitch, Inc.
Potter Instrument

(Continued)

Rawson Elec. Inst. Co.
RCA Div.
Revere Corp.
Rhodes Inc., M. H.
Rutherford Electronics
Sampsel Time Control
Serdex, Inc.
Standard Elec. Time Co.
Stoelting Co., C. H.
Streeter-Amet Co.
Stromberg Electric Co.
Thompson Clock Co.
Walkirt Co.
Wallace & Tiernan
Walser Automatic Timer
Warren Telechron Co.
Westinghouse Elec. & Mfg.
Wilson & Co.
Yellow Springs Inst. Co.

### TIME METERS (See meters, time)

### TIME OPERATION, Recorders

Aero Instrument
Automatic Elec. Chicago
Automatic Temp. Control
Bacharach Ind. Inst.
Bristol Co.
Brown Instrument Div.
Calculagraph Co.
Cincinnati Time Rec.
Cole Instrument
Cramer & Co., Inc.
Dickson Co.
Dorothea Mechanisms, Gale
Elec. Tachometer Corp.
Elematic Sales Corp.
Esterline-Angus Co.
Foxboro Co.
Gaertner Scientific Co.
General Elec. Co.
Gorrell & Gorrell
Gotham Inst. Co.
Instrument Lab., Inc.
Intern'l Business Mach.
Jaeger Watch Co.
Knopf Instrument
Manning, Maxwell & Moore
National Time & Signal
Production Inst. Co.
Service Recorder Co.
Stromberg Time Corp.
Tagliabue Div.
Weksler Thermometer

### TIME STUDY APPARATUS

Alden Products
Alfax Paper & Eng.
Amer. Chronoscope
Automatic Temperature
Bell & Howell
Black & Webster
Clare & Co., C. P.
Clebar Watch Co.
Dietzgen Co., Eugene

(Continued)

Dimco-Gray Co.
Ducommun Co., Eugene
Electric Tachometer Corp.
Gorrell & Gorrell
Knopf Instrument
Lansing Engineering
National Instrument
Seely Instrument Co.
Standard Electric Time Co.
Stoelting Co., C. H.
Technical Instruments
Thompson Clock

### TIME SWITCHES (See Switches, Time)

### TIMERS, AUTOMATIC, Automatic Reset

Alina Corp.
Allen-Bradley Co.
Automatic Elec. Chicago
Automatic Elec. Mfg.
Automatic Temp. Control
Barber-Colman
Betts & Betts
Bristol Co.
Clark Cooper Co.
Cook Electric Corp.
Cramer Co., Inc.
Dorothea Mechanisms, Gale
Eagle Signal Corp.
Edison Instrument Div.
Electronic Controls
Electric Tachometer
Electyme Motor Prods.
Fredericks Co., Geo.
General Controls
General Elec. Co.
Guardian Elec. Mfg. Co.
G-V Controls
Haydon Co., A. W.
Haydon Mfg. Co.
Industrial Timer
Lektra Labs.
Lumenite Electronic
Mason-Neilan Regulator
National Time & Signal
Paragon Electric Co.
Partlow Corp.
Photoswitch, Inc.
Photovolt Corp.
Potter & Brumfield
Potter Instrument
Precision Scientific
Rhodes Inc., M. H.
Seely Inst. Co., Inc.
Stromberg Time Corp.
Struthers-Dunn
Tagliabue Div.
Taylor Inst. Cos.
Walzer Automatic Timer
Wilson & Co., C. G.
Yellow Springs Inst. Co.

### TIMERS, AUTOMATIC, Cycle

Alina Corp.
Am. Gas Accumulator
Assembly Products
Autocall Co.
Automatic Elec, Chicago
Automatic Elec. Mfg.
Automatic Temp. Control
Barber-Colman
Betts & Betts
Bristol Co.
Clark Cooper Co.
Climax Div.
Cook Electric
Cramer Co., Inc.
Dorothea Mechanisms, Gale
Eagle Signal Corp.
Eclipse-Pioneer Div.
Electric Tachometer
Electro-Tech Equip. Co.
Electronic Controls
Electyme Motor Prods.
Fisher Governor
Fisher-Pierce Co.
Foxboro Co.
Fredericks Co., Geo.
General Elec. Co.
Gotham Instrument
Gray Instrument
Hagan Corp.
Haydon Co., A. W.
Haydon Mfg. Co.
Industrial Timer
Industrol Corp.
Lansing Engineering
Lektra Labs.
Lumenite Electronic
Manning, Maxwell & Moore
Miller, M. C.
Minneapolis-Honeywell
Montgomery Mfg. Co.
National Time & Signal
Neomatic Inc.
Paragon Electric Co.
Partlow Corp.
Penn Electric Switch
Photoswitch Inc.
Photovolt Corp.
Potter Instrument
Richardson Allen
Sangamo Electric Co.
Seely Inst. Co., Inc.
Standard Elec. Time
Stromberg Time Corp.
Struthers-Dunn
Tagliabue Div.
Taylor Inst. Cos.
Telechron Inc.
Thompson Clock Co.
Tork Clock Co.
Walser Automatic Timer
Westinghouse Elec.
Weston Elec. Inst. Corp.
Wheelco Inst. Co.
Wilsen & Co., G. C.
Yellow Springs Inst. Co.

### TIMERS, AUTOMATIC, Interval

Abrams Instrument
Aero Instrument
Alina Corp.
Am. Gas Accumulator
Anderson, A. & J. M.
Automatic Elec. Chicago

(Continued)

RECORDERS
RECORD TIME - COUNT QUANTITY

Actuated by an electrical impulse . . . operates on the output of a scaler, photo tube, limit switch or any similar device. Records counts with relation to time and quantity on a roll of tape . . . automatically resets to zero.

**In Radioactive Research**, it saves precious man hours and results in greater economy and efficiency.

**In Industry** it maintains a permanent record automatically, recording production and time each hour.

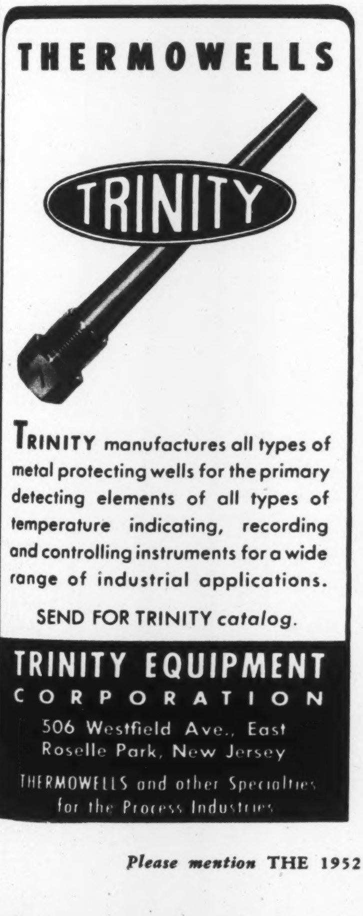
Whatever your counting problems, our Engineering Department can adapt these Recorders to meet your particular need.

Write for interesting
Booklet SC 29

SCALES
WEIGHT RECORDERS
HI-SPEED COUNTERS

FOUNDED 1888

STREETER-AMET COMPANY
4101 N. RAVENSWOOD AVENUE • CHICAGO 13, ILLINOIS



THERMOWELLS

TRINITY

TRINITY manufactures all types of metal protecting wells for the primary detecting elements of all types of temperature indicating, recording and controlling instruments for a wide range of industrial applications.

SEND FOR TRINITY *catalog.*

TRINITY EQUIPMENT CORPORATION
506 Westfield Ave., East
Roselle Park, New Jersey

THERMOWELLS and other Specialties for the Process Industries

NO MORE GUESSWORK!

PROCESS TIMING
*automatically recorded*
*by a Little "TIME CLOCK"*

exactly 8½ minutes
exactly 15 minutes
exactly 2 minutes
exactly 12 minutes
50
40
30
20
10

"The cure must be 8½ minutes"—"the heat must be applied exactly 15 minutes"—"the plating must take just 2 minutes"—"the pigment must be mixed just 12 minutes"—etc.

The *Servis Recorder* checks on this—it records just what happened—it *"times the process."* You are no longer in the dark; from now on you know all day and every day whether your *process timing* is lived up to—or if somebody slipped—if something went wrong to ruin your product for that afternoon, or that whole shift! Write for Process Timing Catalog. The Service Recorder Co., 1375 Euclid Avenue, Cleveland 15, Ohio.

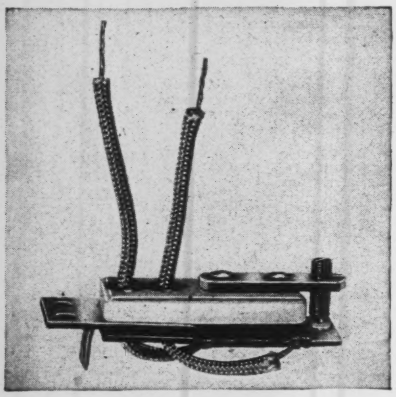
*Bolt this 2 lb. Recorder right to the machine itself; Let the "Process" record itself on the chart—(No ink, no pencil, no wires; the record is recorded in wax).*

The Servis Recorder
*The Time Clock for Machinery*

## ULANET RUGGEDLY DESIGNED

# Miniature THERMAL TIMERS

### Provide timing ranges of 2 seconds to 3 minutes



★ These miniature units actually require a space less than 1⅝" x ⅝" x ½", yet the sturdy design contributes to long life.

A Steatite base provides dimensional stability while mounting is accomplished thru a Bakelite bracket which furnishes complete insulation as well as elimination of pressure on the ceramic member. Electrolytic silver contacts insure best conductivity and longer operation. Stable adjustment is provided for by the clinch-type bracket which holds the adjustment screw. Contact rating is 100 watts 115-230 volts ac.

Of course the Ulanet line includes many other Timing and Thermostat units. Why not investigate the vast line of miniature and sub-miniature designs available. State application or requirements when writing.

**GEORGE ULANET COMPANY**

420 MARKET STREET
NEWARK 5, NEW JERSEY

If your problem is *Heat Control* your solution is *Ulanet*—
Precision Thermostats & Thermal Timers
Exclusively Since 1931

**ULANET**
ELECTRIC HEAT CONTROL
ENGINEERS

Automatic Elec. Mfg.
Automatic Temp. Control
Barber-Colman
Berkeley Scientific
Betts & Betts
Bristol Co.
Cincinnati Time Rec.
Clark Cooper Co.
Controls, Inc.
Cook Electric
Cramer Co., Inc.
Dimco-Gray Co.
Dirigo Compass & Inst.
Dorothea Mechanisms, Gale
Eagle Signal Corp.
Eclipse-Pioneer
Electric Tachometer
Electronic Controls
Electro Products Lab.
Electyme Motor Prods.
Fisher-Pierce Co.
Fredericks Co., Geo.
Gaertner Scientific
General Electric Co.
General Electric X-Ray
Glogau & Co.
Gorrell & Gorell
Gray Instrument
Guardian Elec. Mfg.
Haydon Co., A. W.
Haydon Mfg. Co.
Harvey Radio Labs.
Heiland Research
Industrial Timer Corp.
International Register
Leeds & Northrup
Lektra Labs.
Lumenite Electronic
Lux Clock Mfg. Co.
Minneapolis-Honeywell
Montgomery Mfg. Co.
National Time & Signal
Neomatic Inc.
Paragon Electric Co.
Perfex Corp.
Photoswitch, Inc.
Photovolt Corp.
Potter Instrument
Potter & Brumfield
Productions Inst. Co.
RCA
Revere Corp.
Rhodes, Inc.
Richardson-Allen
Sampsel Time Control
Sangamo Electric
Seely Inst. Co.
Serdex Co.
Skaneateles Mfg. Co.
Standard Elec. Time
Stoelting Co., C. H.
Stromberg Time Corp.
Struthers Dunn
Tagliabue Div.
Taylor Instrument Co.
Telechron Inc.
Thomas Clock Co.
Thompson Clock Co.
Thordarson Elec. Mfg.
Tork Clock
Walser Automatic Timer
Wilson & Co., G. C.
Yellow Springs Inst. Co.

**TIMERS, AUTOMATIC**
**Process**

Alfax Paper & Eng.
Alina Corp.
American Time Corp.
Auth Elec. Spec.
Autocall Co.
Automatic Elec. Chicago
Automatic Elec. Mfg.
Automatic Temp. Control
Barber Colman
Betts & Betts
Bristol Co.
Cincinnati Time Rec.
Clark Cooper Co.
Cook Electric
Cramer Co., Inc.
Denver Fire Clay
Dimco-Gray Co.
Dorothea Mechanisms
Eagle Signal Corp.
Electronic Controls
Electronic Prod. Co.
Electyme Motor Prods.
Fisher-Pierce Co.
Foxboro Co.
Fuel Watchman
Gaertner Scientific Corp.
General Elec. Co.
Genisco Inc.
Gotham Instrument
Gray Instrument
Hagan Corp.
Hansen Co.
Haydon Co., A. W.
Industrial Timer Corp.
International Register
Jardur Import
Lektra Labs.
Lumenite Electronic
Magnetic Gauge Co.
Manning, Maxwell & Moore
Minneapolis-Honeywell
Montgomery Mfg. Co.
National Time & Signal
Neomatic Inc.
Paragon Electric Co.
Partlow Corp.
Photoswitch, Inc.
Photovolt Corp.
Potter & Brumfield
Potter Instruments Co.
Powers Regulator Co.
Richardson-Allen
Seely Inst. Co., Inc.
Serdex, Inc.
Standard Elec. Time
Stromberg Time Corp.
Struthers Dunn
Tagliabue Div.
Taylor Inst. Cos.
Telechron Inc.
Thompson Clock
Tork Clock Co.
Wallace & Tiernan
Weston Elec. Inst. Corp.
Wilson & Co.

# *Standard* TIMERS

**WORLD'S MOST ACCURATE AND RUGGED TIME MEASURING INSTRUMENT. CAN BE MANUALLY OR ELECTRICALLY OPERATED. FURNISHED IN PORTABLE CASES OR FOR PANEL MOUNTING.**

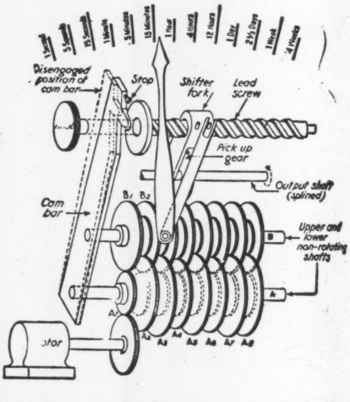
T-1

| Model | Reads | Totalizes | Accuracy |
|---|---|---|---|
| S-100 | 1/5 sec. | 6000 sec. | ±.1 sec. |
| S-60 | 1/5 sec. | 60 min. | ±.1 sec. |
| SM-60 | 1/100 min. | 60 min. | ±.002 min. |
| S-10 | 1/10 sec. | 1000 sec. | ±.02 sec. |
| S-6 | 1/1000 min. | 10 min. | ±.0002 min. |
| S-1 | 1/100 sec. | 60 sec. | ±.01 sec. |
| MST | 1/1000 sec. | .360 sec. | ±.001 sec. |
| MST-500 | 1/1000 sec. | 30 sec. | ±.002 sec. |

**WRITE FOR BULLETIN 153**
*also* Standard Chrono-Tachometers •
Standard Custom-built Laboratory Test and Distribution panels

**THE *Standard Electric Time Co.***
93 Logan Street STANDARD FOUNDED 1884 Springfield, Mass.

## "M" Unit.



This basic unit operates a line of timers, sequence controls, and chart movers. Two types. (A) "M-M" (minute-to-a-month range) with 10 shaft speeds of 1, 5, 15 **minutes**; 1, 4, 12 **hours**; 1, 2⅓, 7, and 28 **days.** (B) "S-M" (second-to-a-month range). 13 speeds of 1, 5, & 15 **seconds** plus the 10 of the M-M unit. 20 oz. inches torque at every speed. ("M"-units are available as components for your own instruments, apparatus and machine tools. Prices from $65.00 singly to $19.75 each in large numbers.) See detailed write-up on page 92 of the July-August 1951 issue of THE INSTRUMENT MAKER Magazine. Be sure to ask for complete catalog.

**OPERATION.** Referring to figure. Two series of double gears rotate freely on fixed shafts A & B. Motor power transmitted from A to B series back and forth $A_1$ to $B_1$ to $A_2$ to $B_2$ etc. Pick-up gear on output shaft is shifted by knob control to desired speed. Pointer shows selection.

*For literature, please write to*

# Gorrell & Gorrell

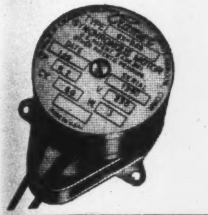
**HAWORTH N. J.**

Cramer

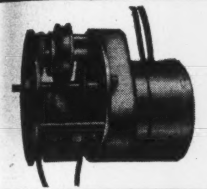
# SYNCHRONOUS MOTORS • ELECTRIC TIMERS

A wide range of timing devices, extensively used on electrically-operated commercial and industrial equipment where accurate, dependable timing is essential to insure efficient product performance . . . to add convenience of operation . . . to prevent work spoilage and protect equipment itself. We are frequently called upon to design special equipment to meet specific requirements . . . consult us about your timing problems. Write for complete information.

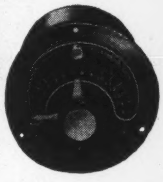
**The R.W. CRAMER Co., Inc., Box # 30, Centerbrook, Conn.**



**TYPE SX SYNCHRONOUS MOTORS** — Widely used for instrument and control applications requiring constant speed at a given frequency. Powerful, precision-built. Produce an exceptionally high torque. Available with output speeds from 60 RPM to 1/24 RPH.



**TYPES SCS-SCR CLUTCH MOTORS** — Designed to meet the needs of many timing, recording, indicating and switching applications requiring reset operation. TYPE SCS — standard clutch type. Type SCR — reversible clutch type.

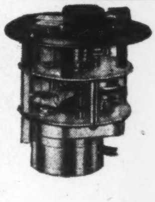


**TYPE IE INTERVAL TIMERS** — Setting to any desired time opens one load circuit, closes another, starting time cycle. Restores to normal position at end of time interval. Designed to control electrically operated equipment such as mixers, X-ray machines, ovens, plating processes, etc.

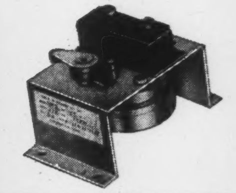
**TYPE IG INTERVAL TIMERS** — Holds one or two circuits either open or closed for pre-set time and returns them to original position at end of interval. Used for built-in applications in microfilming equipment, battery chargers, therapeutic machines, etc.

**TYPE RE RESET TIMERS**— Automatically closes one circuit and opens another for a pre-set time when started. Used for control of process work where accuracy of repeat operation is required — on copying machines, laboratory equipment, photo printers, etc.

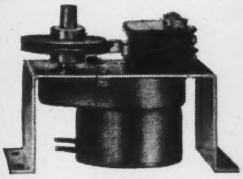
**TYPE TE TIME DELAY RELAYS** — Provides adjustable time delay between closing of control circuit and subsequent closing or opening of load circuit. Used to control heat treating equipment, shakers, etc.



**TYPES TEC - TER TIME DELAY RELAYS** — Provide an adjustable time delay between operation of a control circuit and subsequent closing or opening of load circuit. Used in industrial controls for heat treating, lapping, grinding, induction heating, mixing, etc.

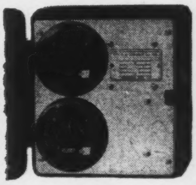


**TYPE TF2 TIME DELAY RELAYS** — Provide a fixed time delay between closing of control circuit and opening or closing of one or two load circuits. Used to protect high voltage electronic tubes, control of signalling devices, machines or process control, etc.



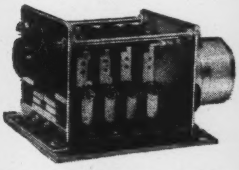
**TYPES CF3 - CF6 CYCLE TIMERS** — For built-in applications where from one to eight circuits are to be controlled in accordance with a predetermined program — commercial dishwashers, ice-making units, to reverse motors, to operate motors, solenoid valves, etc.

**TYPE V PULSE TIMERS** — Continuously electrical impulses of a definite set duration at end of successive identical time intervals. Used for control of automatic lubricators, conveyors, pumps, electron tube testing, etc.

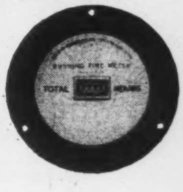


**TYPE DU DUPLEX CYCLE TIMERS** — Designed to open or close one or two load circuits continuously or to perform one complete cycle and stop. Used to control idle and running time of machines, periodic feeding of chemicals to boilers, etc.

**TYPE PE PERCENTAGE TIMER** — Designed to control percent of time in which electrical circuit is closed or open out of definite time cycle. Used to regulate input to electrically operated furnaces, ovens or heaters, etc.



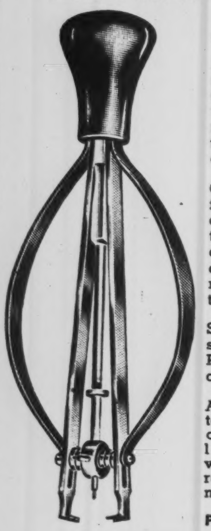
**TYPE M MULTI-CONTACT TIMERS** — Designed to control automatically a number of electrical circuits in predetermined sequence. Used to control a series of machine operations, to reverse motors, valves, signals or combinations in sequence, etc.



**TYPE E RUNNING TIME METERS** — Designed to cumulatively register total operating or idle time of any circuit, machine or system. Used to record operating time of vacuum tubes, to forecast need for servicing of machines, etc.

Pull off Hands and Pointers faster and better with the new patented

PRESTO No. 4 Hand and Pointer Puller



It grips and pulls at the same time.

A great time-saver for repairmen of aircraft instruments, gauges, meters, indicators, watches and clocks.

Center turret has four plungers of different diameters that can quickly be turned to select the right size to fit the center post.

Simply press the side springs and, Pesto! the hands come off.

A precision-made tool of sturdy construction and long durability, which instrument repairmen should not be without.

Price, $4.75

At Jewelers' Tool & Supply Houses, or Write us G. D. Gustafson Mfg. Co.
5328 N. Kedzie St., Chicago 25, Ill.

REPUBLIC PNEUMATIC TRANSMITTERS

Republic pneumatic transmitters are devices for converting process variables, such as flow, liquid level, pressure or liquid density, into air pressures which vary proportionally with the process variables.

These air pressures can be used as the measuring impulse for the actuation of an automatic controller or a direct reading recorder.

WRITE FOR DATA BOOK No. 1002

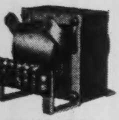
REPUBLIC FLOW METERS CO.
2240 Diversey Pkwy. Chicago 47, Ill.

REPUBLIC INSTRUMENTS • CONTROLS

GRAMER TRANSFORMERS

FOR INDUSTRIAL ELECTRONIC AND ELECTRICAL APPLICATIONS

★ Consult Gramer for POWER TRANSFORMERS UP to 2KVA—REACTORS—AUDIO OUTPUT TRANSFORMERS—INPUT TRANSFORMERS—VOLTAGE REGULATORS—WINDINGS—engineered to your specifications.



HEAVY DUTY FILAMENT TRANSFORMER

POWER TRANSFORMER SHOWS CONSTRUCTION BEFORE PUTTING IN STEEL CASE. BUILT TO MIL-T-27 SPECIFICATIONS.

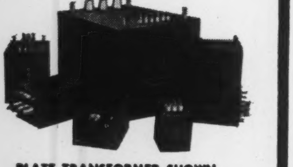


PLATE TRANSFORMER SHOWN (l to r) WITH POWER, FILAMENT, CHOKE, DRIVER, FILAMENT AND SMALLER PLATE TRANSFORMERS ALL BUILT TO MIL-T-27 SPECIFICATIONS HERMETICALLY SEALED

HERMETICALLY SEALED or OPEN TYPES TO GOVERNMENT SPECIFICATIONS

GRAMER TRANSFORMER CORPORATION
2734-II N PULASKI ROAD
CHICAGO 39 ILLINOIS

Submit B/P Specifications
Prompt Service Assured

**TIMERS, AUTOMATIC, Spot Weld**
Allen-Bradley Co.
Am. Gas Accumulator
Automatic Temp. Control
Booth Co., Arthur E.
Cramer & Co., Inc.
Cutler-Hammer, Inc.
Electronic Controls
Electronic Prod. Co.
Electyme Motor Prods.
General Electric Co.
Industrial Timer
National Time & Signal
Neomatic Inc.
Photoswitch, Inc.
Photovolt Corp.
Wilson & Co., G. C.

**TITRATION APPARATUS, Electrometric**
Beckman Instruments
Burrell Technical Supply
Cambridge Instrument Co.
Central Scientific Co.
Coleman Electric Co.
Fisher Scientific Co.
Gray Instrument
Leeds & Northrup Co.
Pfaltz & Bauer
Precision Scientific
Rubicon Co.
Sargent & Co., E. H.
Thomas Co., Arthur H.
Welch Scientific

**TOOLMAKER'S FLATS see Flats, Optical**

**TOOLS, Precision**
Bayside Watch Tool
Daco Machine & Tool
Fonda Gage Co.
Gaunt Industries
Gustafson Mfg. Co.
Levin & Son
Lovins Engr.
Lufkin Rule Co.
Marshall Co.
Standard Products
Woodruff & Stokes

**TOPOGRAPHIC INSTRUMENTS (See Surveying Instruments)**

**TORQUE GAGES (See Gages, Torque)**

**TORQUE MEASURING EQUIPMENT**
Aero Electronics
Airdraulics Engineering
Emery Co., A. H.
Flight Research Eng.
General Elec. Co.
Hagan Corp.
Hathaway Instrument

(Continued)

Martin-Hubbard Corp.
Saxl Instrument
Skyway Prec. Tool
Sturtevant Co.
Trimount Inst. Co.
Vectron, Inc.

**TORSIOGRAPH**
Aero Electronics
**Baldwin Locomotive**
Commercial Research
Consolidated Engg.
Saxl Instrument
Toledo Scale Co.

**TORSION METERS**
Aero Electronics
Airdraulics Engineering
Boulin Inst. Corp.
Chatillon & Sons
Commercial Research
Hathaway Inst. Co.
Riehle Testing Machines
Saxl Instrument
Toledo Scale Co.

**TOTALIZERS, Demand**
American Meter Co.
Esterline-Angus
General Elec. Co.
Landis & Gyr
Leeds & Northrup
Sangamo Electric
Westinghouse Elec.

**TOTALIZERS, Electric Energy**
Autocall Co.
Automatic Elec. Chicago
Bristol Co.
Esterline Angus Co.
General Elec. Co.
Landis & Gyr, Inc.
Leeds & Northrup
Sangamo Electric
Westinghouse Elec.

**TOTALIZERS, Fluid Flow**
American Meter Co.
Askania Regulator Co.
Bailey Meter Co.
Bristol Co.
Brooks Rotameter
Builders-Providence
Engineering Res. & Dev.
Fischer & Porter
Foxboro Co.
General Elec. Co.
Hagan Corp.
Hays Corp.
Henszey Co.
Leeds & Northrup Co.
Leupold & Stevens
Mason-Neilan Regulator
Minneapolis-Honeywell
Mittelman Electronics
National Inst. Labs.
Penn Ind. Inst. Corp.
Republic Flow Meters
Revere Corp.
Simplex Valve & Meter
Smith Meter
Sparling, R. W.
Tagliabue Div.
Taylor Inst. Cos.

**TOTALIZERS, Gas Flow**
American Meter Co.
Bailey Meter Co.
Bristol Co.
Builders-Providence
Fischer & Porter
Foxboro Co.
Hagan Corp.
Hays Corp.
Minneapolis-Honeywell
Penn Ind. Inst. Corp.
Republic Flow Meters
Simplex Valve & Meter

**TOTALIZERS, Running Time**
Aero Instrument Co.
Bristol Co.
Cramer Co., Inc.
Elec. Tachometer Corp.
Gorrell & Gorrell
Industrial Timer Corp.
Photoswitch, Inc.
Production Instrument
Standard Elec Time
Westinghouse Elec. & Mfg.

**TRAFFIC SIGNALLING DEVICES (See Signaling Devices, Traffic)**

**TRAMMELS, Steel Beam**
Lufkin Rule Co.

**"TRANSDUCERS" (Note: a transducer converts one form of POWER into another. For numerous primary measuring elements incorrectly called "transducers," see the correct headings under the measurables, the instruments, etc.)**

**TRANSDUCERS, Ultrasonic**
Branson Instruments, Inc.
Brush Development
Electro-Mec Lab.
Electro Products Labs.
Gen. Precision Lab.
Gulton Mfg. Co.
Laboratory for Electronics
Massa Labs.
Monsell, J. R.
Pacific Div., Bendix
Reed Research
Rutishauser Corp.
Sperry Products

**TRANSFORMERS, Adjustable**
Airdesign, Inc.
Allied Control Co.
American Transformer
Freed Transformer
General Electric

(Continued)

General Radio Co.
Gramer Transformer
Halldorson Co.
Hevi Duty Elec.
Lindberg Engineering
Miller Transformer
Raytheon Mfg. Co.
Sorensen & Co.
Superior Electric Co.
Thordarson Elec. Mfg. Co.
Trenton Transformer
United Transformer

**TRANSFORMERS, Constant Voltage**
Airdesign, Inc.
Better Coils Inc.
Boonton Radio Corp.
Chicago Electronic
Cole Instrument
General Controls
General Electric Co.
Hevi-Duty Elec.
Magnetic Amplifiers
Miller Transformer
Perfex Corp.
Sola Electric Co.
Sorensen & Co.
Standard Transformer
Superior Electric Co.
Thordarson Elec. Mfg.
United Transformer
Westinghouse Elec.

**TRANSFORMERS, Experimenter's Variable Voltage**
Airdesign, Inc.
Allied Control Co.
American Transformer
Better Coils Inc.
Chicago Electronic
DoAll Co.
Dongan Electric Co.
Freed Transformers
General Controls
General Radio Co.
Gramer Transformer
Halldorson Co.
Hevi-Duty Elec.
Merit Transformer
Miller Transformer
Raytheon Mfg.
Sorensen & Co.
Standard Transformer
Sorvall, Ivan
Southwestern Ind. Elec.
Superior Electric Co.
Thordarson Elec. Mfg.
Trenton Transformer
United Transformer
Walker-Jamieson, Inc.

**TRANSFORMERS, Impedance**
Better Coils, Inc.
Freed Transformer Co.
General Electric Co.
Gramer Transformer
Halldorson Co.
Merit Transformer
Miller Transformer
Raytheon Mfg. Co.
Southwestern Ind. Elec.
Sperry Gyroscope Co.
Standard Transformer
Sorenson & Co.

**TRANSFORMERS, Instrument**
Aeromarine Inst. Co.
Airdesign, Inc.
Allied Control Co.
Allis-Chalmers
Amplifier Co.
Annis Co.
Assembly Products
Associated Research
Audio Development
Better Coils, Inc.
Burlington Inst. Co.
Chicago Electronic
**Chicago Transformer**
Cole Instrument
Columbia Elec. Mfg.
Control Corp.
Eastern Specialty Co.
Eclipse-Pioneer Div.
Elec. Facilities, Inc.
Esterline Angus Co.
Federal Telegraph Co.
Freed Transformer
Friez Instrument
General Controls
General Elec. Co.
Gramer Transformer
Hagan Corp.
Halldorson Co.
Hickok Elec. Inst. Co.
Industrial Insts. Inc.
Kollsman Inst. Div.
Manning, Maxwell, Moore
Merit Transformer
Miller Transformer
New York Transformer
Phen-Trols, Inc.
Roller-Smith Co.
Sangamo Electric Co.
Servomechanisms, Inc.
Simpson Electric Co.
Sorensen & Co.
Southwestern Ind. Elec.
Sperry Gyroscope Co.
Standard Science Sup.
Standard Transformer
Sticht Co.
Superior Electric Co.
Thordarson Elec. Co.
Trenton Transformer
Utah Radio Produs.
United Transformer Corp.
Westinghouse Elec.
Weston Elec. Inst. Corp.

**TRANSFORMERS, Insulation Testing**
Airdesign, Inc.
American Transformer
Amplifier Co.
Associated Research
Better Coils, Inc.
Campbell Electric

(Continued)

Chicago Electronic
Cole Instrument
Freed Transformer
General Controls
General Elec. Co.
Gramer Transformer
Lenkurt Electric Co.
Miller Transformer
Raytheon Mfg. Co.
Sherron Metallic
Superior Electric Co.
Thordarson Elec. Mfg.
Trenton Transformer
United Transformer

**TRANSFORMERS, Laboratory**
Airdesign, Inc.
Allied Control Co.
American Inst. Co.
American Transformer
Amplifier Co.
Audio Development
Better Coils, Inc.
Burrell Tech. Supply
Central Scientific Co.
Chicago Electronic
Chicago Transformer
Clough-Brengle Co.
Daven Co.
Eastern Specialty Co.
Elec. Facilities, Inc.
Electro-Tech Equip. Co.
Esterline-Angus
Ferranti Electric
Freed Transformer
General Elec. Co.
General Radio Co.
Gorrell & Gorrell
Gramer Transformer
Halldorson Co.
Harvey-Well Electronics
Hevi Duty Elec.
Hickok Elect. Inst.
Laboratory Equip. Corp.
Lenkurt Electric Co.
Merit Transformer
Miller Transformer
New York Transformer
Raytheon Mfg. Co.
Scientific Glass App.
Sola Electric Co.
Sorenson & Co.
Southwestern Ind. Elec.
Standard Elec. Prod.
Standard Transformer
Superior Electric Co.
Thordarson Elec. Co.
Trenton Transformer
United Transformer Corp.
Westinghouse Elec.
Weston Elec. Inst. Corp.

**TRANSFORMERS, Microwave**
Better Coils, Inc.
Freed Transformer
General Electric Co.
Raytheon Mfg. Co.
Sperry Gyroscope Co.
Sorensen & Co.

**TRANSFORMERS, Phasing**
Airdesign, Inc.
Better Coils, Inc.
Chicago Electronic
Eastern Specialty Co.
Esterline Angus
Freed Transformer
General Elec. Co.
Gramer Transformer
Merit Transformer
New York Transformer
Raytheon Mfg. Co.
States Co.
Thordarson Mfg. Co.
United Transformer Corp.
Westinghouse Elec.

**TRANSFORMERS, Power**
Airdesign, Inc.
Allied Control Co.
Allis-Chalmers
American Transformer
Amplifier Co.
Audio Development
Better Coils, Inc.
Chicago Electronic
Chicago Transformer
Eclipse-Pioneer Div.
Federal Telegraph Co.
Ferranti Electric
Freed Transformer
General Controls
General Elec. Co.
Gramer Transformer
Halldorson Co.
Harvey Radio Labs.
Hevi Duty Electric
Islip Radio Mfg.
Lenkurt Electric Co.
Lindberg Engineering
Merit Transformer
Miller Transformer
New York Transformer
Sampsel Time Control
Sola Electric Co.
Sorensen & Co.
Standard Transformer
Superior Electric
Thermador Elec.
Thordarson Elec. Mfg.
Trenton Transformer
United Transformer
Weston Elec. Inst.

**TRANSFORMERS, Split Core**
Airdesign, Inc.
Allied Radio Corp.
Annis Co.
Assembly Products
Better Coils, Inc.
Chicago Electronic
Cole Instrument
Elec. Facilities. Inc.
Esterline-Angus Co.
Freed Transformer
General Elec. Co.
(Continued)

Gramer Transformer
H-D Elec. Co.
Islip Radio Mfg.
Roller-Smith Co.
Rubicon Co.
Sangamo Electric Co.
Sorensen & Co.
Thordarson Elec. Co.
United Transformer Corp.
Westinghouse Elec.

**TRANSFORMERS, Variable Voltage Testing**
Airdesign, Inc.
Allied Control Co.
American Transformer
Better Coils, Inc.
Chicago Electronic
Federal Telegraph Co.
Freed Transformer
General Electric Co.
General Radio Co.
Gramer Transformer
Merit Transformer
Miller Transformer
Phen-Trols, Inc.
Raytheon Mfg. Co.
Sorensen & Co.
Standard Transformer
States Company
Superior Electric Co.
Thordarson Elec. Mfg.
Trenton Transformer
United Transformer

**TRANSFORMERS, Voltage Regulating**
Airdesign, Inc.
Allied Radio Corp.
Allis-Chalmers
American Transformer
Amplifier Co.
Boonton Radio Corp.
Chicago Transformer
Cole Instrument
Davis & Co., Inc., Dean
General Elec. Co.
Gramer Transformer
Halldorson Co.
Hevi Duty Electric
Magnetic Amplifiers
Miller Transformer
Sola Electric Co.
Sorensen & Co.
Standard Transformer
Superior Electric
Thordarson Elec. Mfg.
Trenton Transformer
United Transformer Corp.

**TRANSITS, Engineer's (See Surveying Instruments)**

**TRANSITS, Pocket**
Ainsworth & Sons
Keuffel & Esser Co.
Leupold & Stevens
Mico Instrument Co.
Suverkrop Instruments
United States Blue Print
Warren Knight Co.
White Co., Inc.

**TRUCK MILEAGE RECORDERS (See Meters, Mileage)**

**TRUCK-TIME RECORDERS**
Service Recorder Co.
U. S. Taximeter

**TRUCK, TIME & MILEAGE RECORDERS**
Cramer & Co., Inc.
Sangamo Electric Co.
U. S. Taximeter

**TUBE FITTINGS**
Crawford Fitting Co.
Imperial Brass Co.
Metal Goods Corp.
Parker Appliance Co.

**TUBES (See Gas & Vapor Discharge Tubes)**

**TUBES, Cathode Ray (See Oscillographs, Cathode Ray)**

**TUBES, Nessler (See Nessler Tubes)**

**TUBES, Oil Centrifuge (See Oil Centrifuge Tubes)**

**TUBES, Photoelectric**
Continental Electric Co.
General Elec. Co.
General Scientific Co.
Instrument Dev. Labs.
Precise Measurements
RCA Div.
Vacutron, Inc.
Walker-Jamieson, Inc.

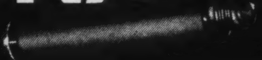
**TUBES, Pitot (See Flowmeters, Pitot Tube)**

**TUBES, Polariscope**
American Inst. Co.
Bausch & Lomb Optical
Central Scientific Co.
Fecker, J. W.
Gaertner Scientific Corp.
Hellige, Inc.
Jarrell-Ash Co.
Koehler Instrument
Precision Scientific Co.
Rudolph & Sons
Sargent & Co.

**TUBES, Precision Bore (See Precision Bore Glass Tubing)**

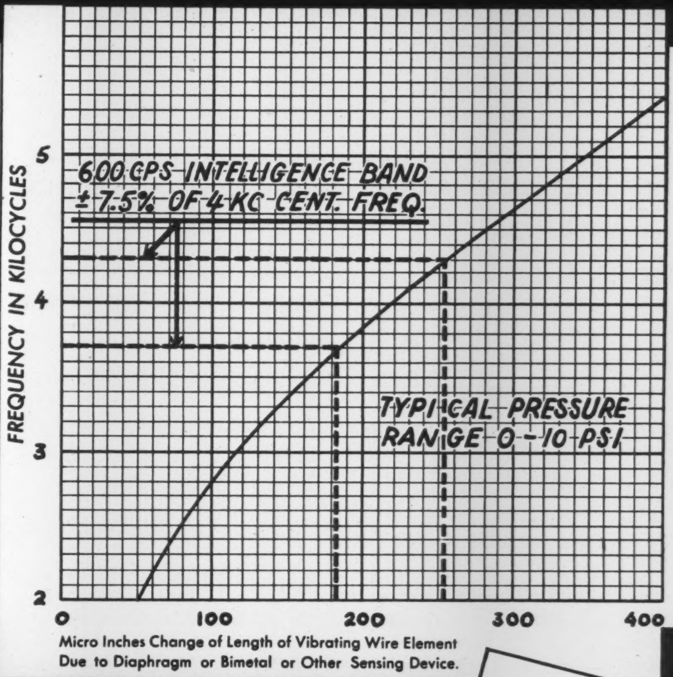
**TUBES, Pyrometer**
Bristol Co.
Campbell Co., J. A.
Eitzen Co.
Elematic Equip. Corp.
Englehard, Chas.
Fish-Schurman Corp.
Foxboro Co.
Gordon Co., Claud S.
Illinois Testing Labs.
(Continued)

SIGNATRON



1/2 ACTUAL SIZE

F/M TRANSDUCERS

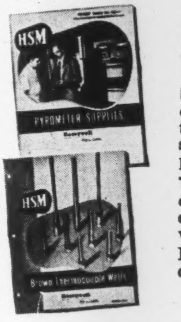


High Q electro mechanical sensing elements of marked stability. Standard design ranges from 1 to 25 kc center frequency with resolving power of 1 part per 1000 over pressure ranges of 0 to 500 psi; acceleration ranges of 0 to 100 g; and temperature ranges –100° C. to 200° C. Special units available with resolving powers up to 1 part in 10,000.

ADDITIONAL APPLICATIONS
- ANGULAR POSITION
- DISPLACEMENT
- LIQUID LEVEL
- FLUID FLOW
- VIBRATION
- VOLTAGE
- CURRENT
- POWER
- WEIGHT

WRITE FOR BULLETIN 812-S

RAHM INSTRUMENTS, INC.
12 West Broadway, New York 7, N. Y.



PYROMETER SUPPLIES BUYERS' GUIDE
THERMOCOUPLE WELLS CATALOG

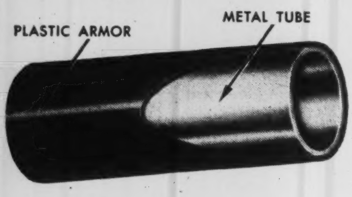
**PYROMETER SUPPLIES BUYERS' GUIDE No. 100-4** contains complete data for ordering base metal, noble metal and special purpose thermocouples, protecting tubes, thermocouple elements, insulators, extension wire, charts, ink, etc. Full specifications and prices are included.

**THERMOCOUPLE WELLS CATALOG No. 200-1** contains information on these units in most machineable metals . . . including detailed data on sizes, lengths, styles and wall thicknesses.

Write today for your copies. MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4579 Wayne Ave., Philadelphia 44, Pa.

MINNEAPOLIS Honeywell
Brown Instruments

Here's
Dekoron®



...the instrument tubing that eliminates external corrosion

Here's an instrument tubing that lowers your costs by eliminating external corrosion. It's Dekoron tubing—plastic armor, polyethylene or vinyl, extruded to a 1/32nd-inch thickness over a metal core—steel, aluminum or copper.

Look at its advantages:

**LONG LIFE.** In an iso-proponol plant, copper lines with bronze fittings were destroyed in less than six months by moisture and fumes. Dekoron lines are in excellent condition after three years service.

**LOW INITIAL COST.** Dekoron tubing is about half as costly as stainless steel or other corrosion-resistant alloys.

**LOW INSTALLATION EXPENSE**—as easy to work and as quickly installed as bare copper or aluminum tubing.

**NO EXPENSIVE PAINTING** or other costly maintenance is required.

**WRITE FOR THE DATA SHEET.** "Dekoron—a better kind of corrosion-resistant instrument tubing." Tells how Samuel Moore & Company coats customers' tubing and lowers costs. Just mail the coupon below.

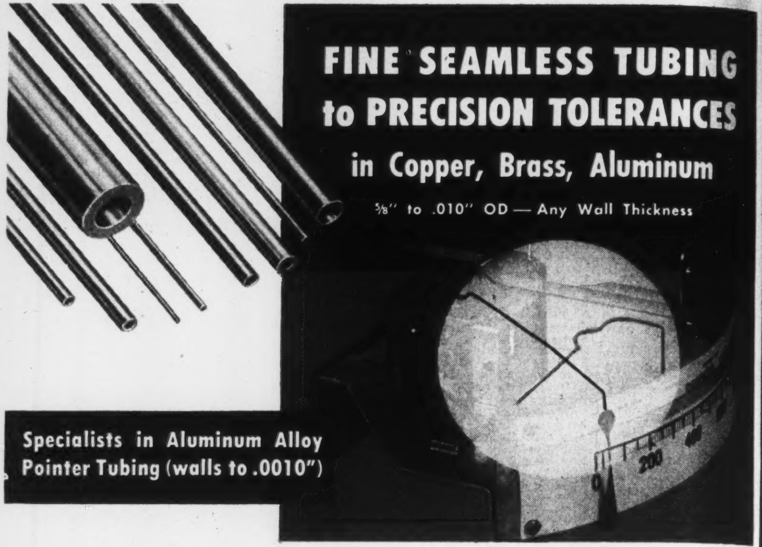
A-3991

Dekoron tubing
PLASTIC ARMORED METAL

SAMUEL MOORE & COMPANY
MANTUA, OHIO

Dept. 15, Samuel Moore & Co., Mantua, Ohio.
Please send me at no obligation your new data sheet, "Dekoron—a better kind of corrosion-resistant instrument tubing."

NAME________________________
FIRM________________________
POSITION ______________________
STREET _______________________
CITY____________ STATE______



FINE SEAMLESS TUBING to PRECISION TOLERANCES
in Copper, Brass, Aluminum
5/8" to .010" OD — Any Wall Thickness

Specialists in Aluminum Alloy Pointer Tubing (walls to .0010")

Photo courtesy Brown Instruments Div., Minneapolis-Honeywell Regulator Co.

"Metal Shielded Wire" (pat.) also furnished. Write for information.

Our new plant at Collegeville, Pa., gives us 2½ times greater production capacity, assuring you quick delivery—less than 6 weeks on most orders.

UNIFORM TUBES
Collegeville 2, Pennsylvania
AGENTS IN CHICAGO AND ST. PAUL

Leeds & Northrup Co.
Minneapolis-Honeywell
Moeller Instrument Co.
Morganite, Inc.
Pyrometer Service Co.
Revere Corp.
Richards, Arklay S.
Taco West Corp.
Tagliabue Div.
Taylor Instrument Cos.
Thermo-Electric Co.
Thwing-Albert Inst. Co.
Trinity Equipment
Turner Electric Co.
Wheatstone Corp.
Wheelco Instruments

**TUBES, Spectrum (See Spectrum Tubes)**

**TUBES, Ultra-Violet Light (See Light Sources)**

**TUBES, Vacuum**
Central Scientific Co.
Continental Corp.
Eclipse-Pioneer
Eitel-McCullough
Electronic Products Co.
Electrons, Inc.
Federal Telephone
Frederick Co., George
General Elec. Co.
General Scientific Corp.
Lewis & Kaufman
Machlett Labs.
North Amer. Philips
Passaic Analytical Labs.
Raytheon Mfg. Co.
RCA Div.
Standard Arcturus
Sorensen & Co.
Sperry Gyroscope Co.
Sylvania Elec. Prod.
United Electronics
Universal X-Ray Products
Vacutron Inc.
Varian Associates
Victoreen Instrument
Walker-Jamieson, Inc.
Wheelco Inst. Co.

**TUBES, Venturi (See Flowmeters, Venturi)**

**TUBES, X-Ray**
American Inst. Co.
Baird Associates
Corning Glass Works
Eureka X-Ray Tube
General Elec. X-Ray Dept.
High Voltage Eng.
Jarrell-Ash Co.
Kelley Koett Mfg.
Machlett Labs.
North Amer. Philips
Picker X-Ray
Standard Arcturus

(Continued)

Stoelting Co., C. H.
Universal X-Ray Prods.
Westinghouse Elec.
Westinghouse X-Ray Co.
Wyland George

**TUBING, Air & Hydraulic**
Aluminum Co. of Am.
Precision Tube
Reynolds Metals
Summerill Tubing
Superior Tube

**TUBING: Anticorrosion coatings for—**
Samuel Moore

**TUNING FORKS, Electrically Driven (See Forks, Tuning)**

**TURBIDIMETERS**
American Inst. Co.
Bowen & Co.
Cargille, R. P.
Central Scientific Co.
Electric Eye Equipment
Ess Instrument Co.
Ferguson Co.
Fisher Scientific Co.
General Electric
Hellige, Inc.
Klett Mfg. Co.
Kimble Glass Co.
Parr Instrument Co.
Pfaltz & Bauer, Inc.
Phipps & Bird
Photoswitch, Inc.
Photovolt Corp.
Precision Scientific Co.
Rawson Electrical Inst.
Rubicon Co.
Sensitive Research Inst.
Zeiss, Inc., Carl

**TURN & BANK INDICATORS**
Aeromarine Inst. Co.
Doelcam Corp.
Eclipse-Pioneer Div.
General Electric
Kollsman Inst. Co.
Summers Gyroscope

**TURN INDICATOR TESTERS (See Testers, Turn indicator**

**TWEEZERS**
Bayside Watch Tool
Ideal Laboratory Tool
Lindly & Co.
Marshall Co.
Michrochemical Service
Park Sales Co.
Stratex Instrument Co.

**TWIST COUNTERS (See Counters, Twist)**

**ULTRA-VIOLET INDICATORS & RECORDERS**
Beckman Instrument Co.
Farrand Optical
General Electric Co.
Hanovia Chem. & Mfg. Co.
Menlo Research Lab.
Nuclear Inst. & Chem.
Photovolt Corp.

**ULTRA-VIOLET LIGHT SOURCES (See Light Sources)**

**U-TUBE MANOMETERS (See Manometers)**

**VACUUM GAGES, Discharge**
Distillation Products
Manning, Maxwell, Moore
National Research
RCA Div.
Universal X-Ray Prods.
Skaneateles Mfg.

**VACUUM GAGES, Hot-Wire**
Baird Associates
Continental Elec. Co.
Distillation Products
Fredericks Co., Geo.
General Elec. Co.
General Physical Lab.
Hastings Instruments
National Research
Process & Instruments
Universal X-Ray Prods.
Victory Engr.
Winslow Co.

**VACUUM GAGES, Ionization**
Central Scientific Co.
Distillation Products
Eitel McCullough
Fredericks Co., Geo.
General Elec, Co.
National Research
Nuclear Inst. & Chem.
Precision Scientific
Process & Instruments
RCA Div.
Stoelting Co., C. H.
Sylvania Electric Prod.
Universal X-Ray Prods.
Welch Scientific
Winslow Co.

**VACUUM GAGES, Liquid-column**
American Meter Co.
Bacharach Industrial Inst.
Bailey Meter Co.
Defender Automatic Reg.

(Continued)

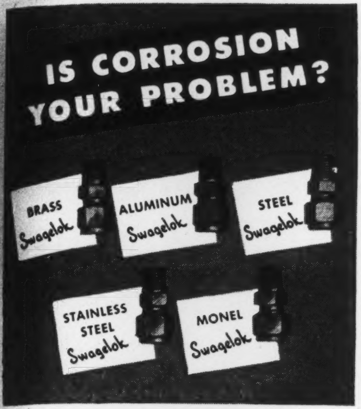
Distillation Products
Dwyer Mfg. Co.
Ferguson Co.
Foxboro Co.
Gas Appliance Specialties
General Electric
Ideal Lab. Tool
Jerguson Gage & Valve
Kontes Glass Co.
Meriam Instrument
Moeller Inst. Co.
Parks Co., Harry S.
Phoenix Prec. Inst.
Pioneer Instrument
Precision Thermometer
Scientific Glass Apparatus
Tagliabue Div.
Taylor Inst. Cos.
Trerice Co.
Uehling Instrument Co.
Universal X-Ray Prods.
Wallace & Tiernan
Welch Scientific

**VACUUM GAGES, McLeod**
Ace Glass, Inc.
Central Scientific Co.
Distillation Products
Electronic Products Co.
Ferguson Co.
General Elec. Co.
General Physical Lab.
Hays Corp.
Kontes Glass Co.
Macalaster Bicknell Co.
Phoenix Prec. Inst.
Podbielniak, Inc.
Scientific Glass Apparatus
Stoelting Co., C. H.
Stokes Machine Co.
Universal X-Ray Prods.
Welch Scientific

**VACUUM GAGES, Pirani Type**
Continental Electric
Distillation Products
Ferguson Co.
Fredericks Co., George
General Elec. Co.
Macalaster Bicknell
Sylvania Elec. Prod.
General Physical Lab
Process & Instruments
Universal X-Ray Prods.
Victory Engr.
Welch Scientific
Winslow Co.

**VACUUM GAGES, Thermocouple**
Distillation Products
Fredericks Co., George
General Electric Co.
Hastings Instruments
National Research
RCA Div.

(Continued)



**When you make every tube connection a Swagelok* connection you relieve yourself of bothersome small leaks in instrumentation lines. In addition, by standardizing on Swagelok fittings inventories are reduced and control simplified, component parts are interchangeable and tube connections are made faster and easier. Swagelok fittings form a leakproof, torque-free seal with one and one quarter turns.**

***FREE***—For complete details and descriptive literature write Dept. IN.
*Patented

**CRAWFORD FITTING CO.**
**884 E. 140th St., Cleveland 10, Ohio**

Sylvania Elec. Prod.
Universal X-Ray Prods.
Welch Scientific
Winslow Co.

### VACUUM INDICATORS

Aeromarine Inst. Co.
American Meter Co.
Ashton Valve Co.
Bailey Meter Co.
Baird Associates
Bristol Co.
Central Scientific Co.
Distillation Products
Engineering Res. & Dev.
Foxboro Co.
Fredericks Co., George
General Elec. Co.
General Physical Lab.
Gotham Inst. Co.
Hastings Instruments
Hays Corp.
Kollsman Inst.
Manning, Maxwell & Moore
Marsh Corp.
Mason-Neilan Regulator
Meriam Instrument
Minneapolis-Honeywell
Moeller Instrument Co.
National Research
Potter Co.
Precision Scientific
Precision Therm.
Process & Instruments
Rawson Electrical Inst.
Republic Flow Meters
Rochester Mfg. Co.
Schauer Mfg. Co.
Scientific Glass App.
Skaneateles Mfg.
Star Brass Mfg. Co.
Statham Labs.
Stoelting Co., C. H.
Tagliabue Div.
Taylor Inst. Cos.
Trerice Co.
Uehling Instrument Co.
U. S. Gauge
Universal X-Ray Prods.
Victory Engr.
Wallace & Tiernan
Weksler Thermometer

### VACUUM, HIGH (below 1 mu) Controllers, Indicators & Recorders

Baird Associates
Continental Elec. Co.
Distillation Products
Electronic Prod. Co.
Fredericks Co., Geo.
General Elec. Co.
General Physical Lab.
Manning, Maxwell, Moore
National Research
Process & Instruments
Shallcross Controls

(Continued)

Stoelting Co., C. H.
Taylor Instrument Cos.
Universal X-Ray Prods.
Weksler Thermometer
Welch Scientific

### VACUUM, HIGH (below 500 mu) Controllers, Indicators, Recorders

Distillation Products
General Physical Lab.
Manning, Maxwell, Moore
Process & Instruments
Skaneateles Mfg.
Universal X-Ray Products
Winslow Co., Inc.

### VACUUM RECORDERS

American Meter Co.
Ashton Valve Co.
Bailey Meter Co.
Bristol Co.
Defender Inst. & Reg.
Dickson Co.
Distillation Products
Engineering Res. & Dev.
Esterline Angus Co.
Fish-Schurman Corp.
Foxboro Co.
Fredericks Co., George
Gotham Inst. Co.
Hays Corp.
Manning, Maxwell, Moore
Marsh Corp.
Mason-Neilan Regulator
Minneapolis-Honeywell
National Research
Penn Ind. Inst. Corp.
Precision Scientific
Republic Flow Meters
Schwien Engineering
Scientific Instrument Co.
Skaneateles Mfg.
Tagliabue Div.
Taylor Inst. Cos.
Trerice Co.
Uehling Instrument Co.
Weksler Thermometer

### VACUUM SPECTROGRAPHS (See Spectrographs, Vacuum)

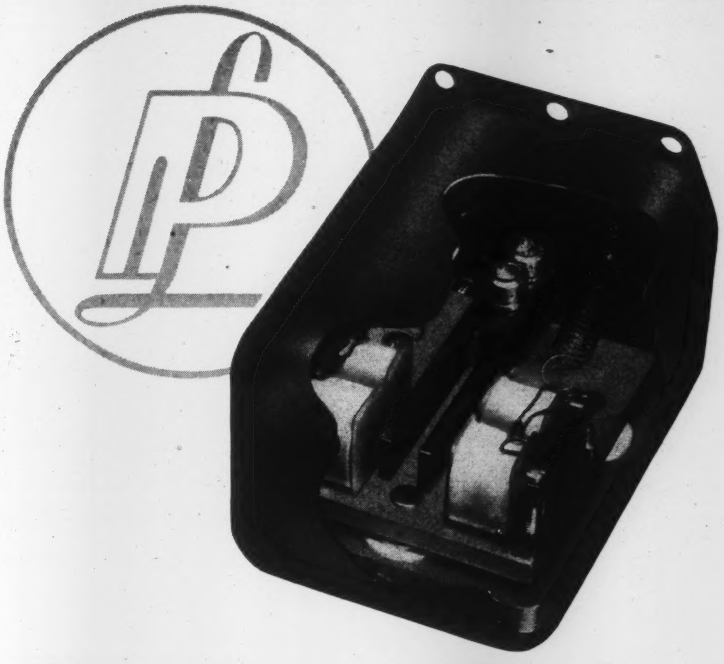
### VACUUM TUBES (See Tubes, Vacuum)

### VACUUM TUBE BRIDGES (See Bridges Electrical, Vacuum Tube)

### VACUUM TUBE RELAYS (See Relays, Vacuum Tube)

### VACUUM TUBE VOLTMETERS (See Voltmeters, Vacuum Tube)

### VALVE BOX FINDER (See Finder, Valve Box)



**Tuning Forks**

**for precision frequency control**

**A complete line of tuning fork resonators to meet your reference standard . . . timing . . . or speed control requirements.**

**ACCURATE** . . . Manufactured in accuracies up to 1 part in 10,000 for operation from -40 to +75°C.—and up to 1 part in 100,000 for operation from 0 to +75°C.

**COMPENSATED** . . . Thermal compensation method employed maintains fork accuracy throughout rated operating temperature range without benefit of oven control or warm-up time.

**RUGGED** . . . Internally shock-mounted using relatively permanent, semi-inorganic, silicone rubber—a desirable feature for stringent shock and vibration applications.

**HERMETICALLY SEALED** . . . Solder-sealed evacuated container prevents barometric pressure and relative humidity variations from affecting fork accuracy.

**FREQUENCIES** . . . 400 cycles and from 700 to 3,000 cycles for accuracies up to 1 part in 10,000—from 1,000 to 3,000 cycles for accuracies up to 1 part in 100,000.

*Available individually—as a part of compact subassemblies—or in completely engineered equipment constructed to your specifications.*

*Write Dept. A for complete information or telephone HYacinth 2-4800.*

***PHILAMON LABORATORIES***
***5717 Third Avenue Brooklyn 20, N. Y.***

For Tubing WHEN PRECISION COUNTS
. . . COUNT ON PRECISION!

Nth DEGREE ACCURACY IN SMALL, NON-FERROUS, SEAMLESS TUBING FOR

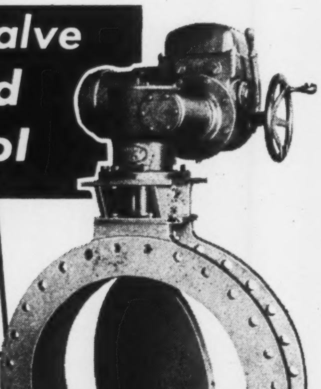
**PRESSURE GAUGES**—Tubing for pressure measurement has constant wall thickness, consistent spring properties, and precise uniformity . . . is produced in shapes and sizes to meet exact specifications.

**POINTERS**—Pointer Tubing made of 3S, 17S, or 52S Aluminum Alloy provides high strength-to-weight ratio, corrosion resistance, and a clean smooth finish. Available in all sizes down to 0.010" O.D. with wall thicknesses down to 0.0015".

**COAXITUBE**—A unique metal-shielded wire consisting of an inner conductor, dielectric, and a seamless tube assembled coaxially. Available in copper, brass, aluminum, or nickel, Coaxitube assures positive conductor protection.

**OTHER TYPES**—Precision Tubing for other uses covers a range of 0.500" O.D. to 0.010" O.D., wall thicknesses down to 0.0015" . . . held to extremely close tolerances. Made in most non-ferrous metals. Can be shaped to exact specifications. Write for catalog.

**PRECISION TUBE CO. INC.**
NORTH WALES, PENNSYLVANIA — BRANCHES IN PRINCIPAL CITIES



Get Both in One Valve
Automatic and
Manual Control

ROCKWELL
BUTTERFLY
VALVES

For control and quick shut-off of air, gases, chemical fluids, water, etc., the trend is to automatic valves, but many are also equipped with lever or handwheel devices for auxiliary handwheel operation. Such combinations are available on Rockwell Valves in all sizes to 72".

Rockwell Valves are built in all metals and rubber-covered for operation to 100 p.s.i. from sub-zero to high temperatures.

Get our Valve Catalog—and ask to receive "Rockwell Valve News" monthly

*This 30" pipe size Rockwell Butterfly Valve for 60 p.s.i. operating pressure is equipped with a Phillie Gear Limitorque Motor Control plus a handwheel for emergency manual operation. When installed, two indicating lights show fully open and fully closed position.*

ROCKWELL SINCE 1888 BUILT

W. S. ROCKWELL COMPANY
Slide and Butterfly Valves • Steam Traps • Oil Burners
264 Eliot Street • Fairfield, Conn.

**VALVE-OPERATING DEVICES, Electric Motor**
Allis-Chalmers
Automatic Temp. Control
Baldwin-Lima-Hamilton
Barber-Colman Co.
Beck Co.
Bristol Co.
Brooke Engineering
Clark Cooper Co.
Cleveland Fuel Equip.
Climax Div.
Continental Equip. Co.
Cramer & Co., Inc.
Cutler-Hammer, Inc.
Dickson Co.
Eclipse-Pioneer Div.
Foxboro Co.
General Controls Co.
General Electric Co.
General Regulator Corp.
Hays Corp.
Jenkins Bros.
Keckley Mfg. Co.
Minneapolis-Honeywell
Lear, Inc.
Leeds & Northrup
Lumenite Electronic
McAlear Mfg. Co.
Philadelphia Gear Works
Robinette Co., W. C.
R-S Products
Schwien Engr.
Shallcross Controls
Tagliabue Div.
Wilson & Co.

**VALVE OPERATING DEVICES, Electric Solenoid (See Valves, Solenoid)**

**VALVE OPERATING DEVICES, Hydraulic (See Valves, Hydraulically Operated)**

**VALVE-OPERATING DEVICES, Pneumatic (See Valves, Diaphragm)**

**VALVE POSITION INDICATORS**
Allis-Chalmers
Autocall Co.
Automatic Temp. Control
Bailey Meter Co.
Barber Coleman
Beck Co.
Bendix Marine Products
Bristol Co.
Builders-Providence
Conoflow Corp.
Cutler-Hammer, Inc.
Elec. Indicator Corp.
Elec. Tachometer Corp.
Fischer & Porter
Fisher Governor
Foxboro Co.
General Controls
General Electric Co.
General Regulator Corp.
Hammel-Dahl Co.
Kieley & Mueller
Lear, Inc.
Leupold & Stevens
Manning, Maxwell & Moore
Moore Products
Northern Equip. Co.
Republic Flow Meters
Tagliabue Div.
Taylor Inst. Cos.
Tejax Eng. Corp.
Westinghouse Elec. & Mfg.
Wheelco Instrument

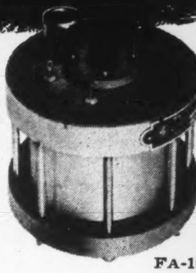
**VALVE POSITIONERS**
Bristol Co.
Brown Inst. Div.
Foxboro Co.
Mason-Neilan Reg. Co.
Moore Products Co.
Penn Ind. Inst. Corp.
Taylor Inst. Cos.

**VALVES, Automatic Shut-off**
Adel Precision Prods.
Annin Co.
Askania Regulator Co.
Atlas Valve Co.
Automatic Switch Co.
Automatic Temp. Control
Automatic Valve Control
Barber-Colman
Bastian-Blessing
Cash Co.
Clark Cooper Co.
Climax Div.
Continental Equip. Co.
Davis Reg. Co.
Edison, Instrument Div.
Farris Engineering
Fisher Governor
Flexible Valve Corp.
Foster Engg. Co.
Frick Co.
Friez Instrument
General Controls Co.
Grove Regulator
Hills-McCanna
Jerguson Gage Co.
Kieley & Mueller
Leslie Co.
Manning, Maxwell & Moore
Mason-Neilan Regulator
McAlear Mfg.
Milwaukee Gas Spec.
Minneapolis-Honeywell
North Amer. Mfg. Co.
OPW Corp.
Parlow Corp.
Paul Valve Co.

(Continued)

# FOR DEEP VACUUM OPERATIONS

## THE W&T ABSOLUTE PRESSURE CONTACTOR



FA-193

This sensitive, yet durable aneroid device is used for actuating an electric circuit at a preset value of absolute pressure.

Outstanding features of the Contactor, type F-193, include:

| | |
|---|---|
| Range of adjustment | 0-2 mm Hg. and other ranges made to customer's specifications up to 800 mm Hg. absolute pressure. |
| Sensitivity | will make or break within 0.10 mm Hg. |
| Contact rating | 5 ma at 115 volts A.C. |
| Repeatability | 0.10 mm Hg. |

Vacuum-tight construction
Over pressure protection

*Additional Information Will Be Supplied On Request*

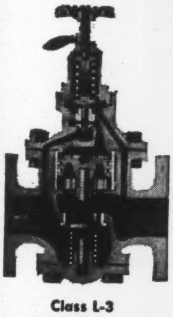
A-86

**WALLACE & TIERNAN**
**PRODUCTS, INC.**
ELECTRICAL MECHANISMS AND PRECISION INSTRUMENTS
Belleville 9 New Jersey • Represented in Principal Cities

---

# LESLIE Reducing Valves for PLANT STANDARDIZATION

Standardization of regulating equipment for industrial plants has been a subject strongly emphasized by LESLIE for many years to reduce maintenance costs, and store's requirements for repair parts, to increase flexibility in operation and conversion.



Class L-3
LESLIE Pressure
Reducing Valve

*LESLIE offers these plant standardization values:*

- ★ **DEPENDABLE APPROVED PERFORMANCE**
- ★ **LOWEST OVERALL COST PER OPERATING YEAR**
- ★ **WIDE RANGE OF ADJUSTMENT**
- ★ **INTERCHANGEABILITY OF INTERNAL PARTS**
- ★ **RENEWABLE PARTS**
- ★ **RECOGNIZED QUALITY AND WORKMANSHIP**
- ★ **A COMPLETE LINE OF REGULATORS**

**SEND FOR** your copy of Bulletin—"Reducing Valves, How to Select and Install".

**LESLIE CO.**
299 Grant Ave. Lyndhurst, New Jersey

ESTABLISHED 1900
LESLIE
CO.

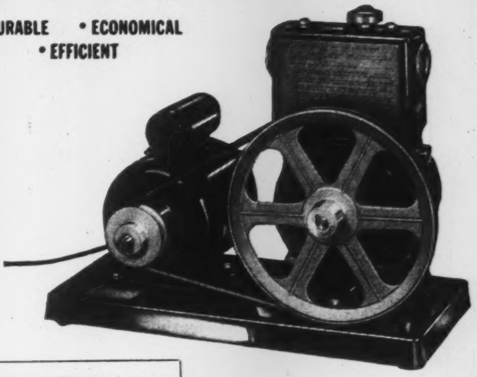
PRESSURE REDUCING VALVES • • PRESSURE CONTROLLERS
PUMP GOVERNORS • • • TEMPERATURE REGULATORS
SELF CLEANING STRAINERS • • LESLIE TYFON WHISTLES

---

# WELCH

## Precision Built Duo-Seal Vacuum Pumps

• DURABLE • ECONOMICAL
• EFFICIENT



**$210.00** Complete with Motor

1. HIGH VACUUM
   0.1 Micron Guaranteed
2. FREE AIR CAPACITY
   58 Liters Per Minute
3. FAST PUMPING
   at all Pressures
4. CONTINUOUS OPERATION
5. DEPENDABLE RESULTS
6. QUIET OPERATION
7. LONGER LIFE

**Pumps of other sizes and capacities**
***Write for details.***

## — Electrical Measuring Instruments —

*dependable sensitive accurate rugged*

**—PANEL—**
**METERS FOR PRODUCTION**

**—SWITCHBOARD—**
**POWER HOUSE METERS**

**PORTABLE LABORATORY STANDARDS**

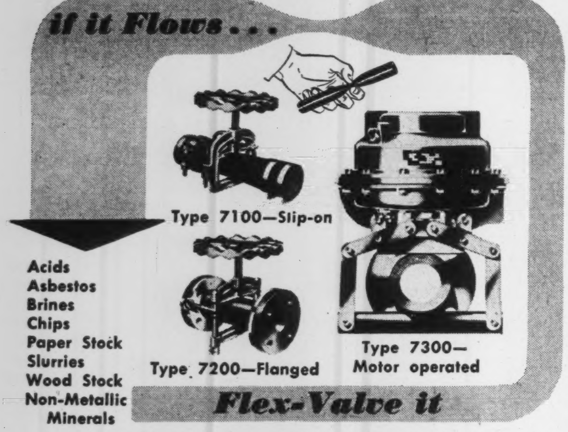
**Master Model Type W No. 3027**

SPECIFICATIONS:

Sapphire Jewels—High Carbon Tool Steel Pivots—
All metal parts are rustproof—
Alnico Magnets are used in all Welch Meters.
SPECIAL METERS AVAILABLE ON ORDER

***Write for 48 page Meter Booklet.***

**W. M. WELCH SCIENTIFIC COMPANY**
Established 1880
1515 SEDGWICK STREET DEPT. B [illegible] CHICAGO [illegible] ILLINOIS U.S.A.



*if it Flows . . .*

Acids
Asbestos
Brines
Chips
Paper Stock
Slurries
Wood Stock
Non-Metallic
Minerals

*Flex-Valve it*

FLEX-VALVE is the ideal choice for handling such materials as those listed—either dry or in suspension—at temperatures up to 210 deg.

Resists both abrasion and corrosion; eliminates clogging, plugging, building up; absorbs vibration and misalignment.

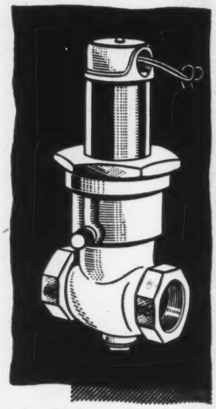
Open—it's as free of obstruction as the pipe itself. Closed—it's bubble-tight and it closes tight on all of these materials.

Available in either hand or air operated types in sizes from ½ to 12 in.

Users have found FLEX-VALVE to be the low-cost solution to tough valving problems. If your present valves aren't 100% effective, take a look at this one. Catalog 455 gives details.

FLEX VALVE

**Flexible Valve Corporation**
336 COMMERCIAL AVE. • PALISADES PARK, N. J.



ATKOMATIC
EXTRA RUGGED
ELECTRICALLY OPERATED
VALVES

In thousands of installations . . . in this and other countries . . . Atkomatic Valves continue to give years of dependable, trouble-free service. That's because they are *extra rugged*—built to take *more* than you will demand. Compact and simple, they are made for pressures of one to 3,000 pounds. In your plant or on your product, you can count on ATKOMATIC. Send us your individual problem . . . maybe we've already solved it!

ATKOMATIC VALVE COMPANY, INC.
545 W. ABBOTT STREET, INDIANAPOLIS, INDIANA

*Send For Literature*

DIAPHRAGM OPERATED
CONTROL VALVES
in CORROSION
RESISTING
ALLOYS

PROMPT DELIVERIES, because they're machined from available barstocks . . . NO CASTING DELAYS!

Your requirements for pneumatic control valves in many unusual alloys can be met promptly with CONOMOTOR Type AB-10 Barstock body valves. Available in ½", ¾" and 1" nominal pipe sizes with screwed connections. Standard 600 pound pressure rating can be furnished as semi-standard for pressures to 3,000 psi (cold).

REQUEST BULLETIN AB-10-2-1

STANDARD MATERIALS AVAILABLE

Hastelloy
Durimet
Monel
Everdur
Nickel

And most other machineable metals

Cono Controls

CONOFLOW CORPORATION
[illegible] Arch St., Phila. 3, Pa.

Phillips Petroleum
Preferred Utilities
R-S Prod. Corp.
Schade Valve Mfg. Co.
Seely Inst. Co., Inc.
Sinclair-Collins Valve
Skaneateles Mfg. Co.
Smith Meter
Tagliabue Div.
Valvair Corp.
Vapor Recovery Systems
Wheelco Instruments

**VALVES, Automatic Solenoid (See Valves, Solenoid)**

**VALVES, Balanced**

Acme Scientific
American Meter Co.
Atlas Valve Co.
Bailey Meter Co.
Baldwin Locomotive
Barber Colman
Boylston Co.
Bristol Co.
Cash Co.
Clark Cooper Co.
Climax Div.
Conoflow Corp.
Davis Reg. Co.
Defender Inst. & Reg.
Dennison Engineering
Fischer & Porter
Fisher Governor Co.
Ford Reg. Valve Co.
Foster Engg. Co.
Foxboro Co.
General Controls Co.
Hammel-Dahl Co.
Jenkins Bros.
Keckley Mfg. Co.
Kieley & Mueller
Klipfel Mfg. Co.
Leslie Co.
Mason-Neilan Regulator
McAlear Mfg.
Minneapolis-Honeywell
Natural Gas Equipment
North Amer. Mfg. Co.
Northern Equip. Co.
OPW Corp.
Powers Regulator Co.
Republic Flow Meters
Reynolds Gas Regulator
Schade Valve Mfg. Co.
Seely Inst. Co., Inc.
Sinclair Collins Valve
Spence Engineering Co.
Swartwout Co.
Tagliabue Div.
Trerice Co.
Watts Regulator Co.
Wood, Harry W.

(Continued)

**VALVES, Constant Pressure**

Assoc. Valve & Engrg.
Atlas Valve
Bailey Meter Co.
Bastian-Blessing Co.
Brooke Engineering
Cash Co.
Clark Cooper Co.
Climax Div.
Davis Reg. Co.
Dennison Engineering
Fisher Governor Co.
Foster Engg. Co.
General Controls
Grove Regulator
Hammel-Dahl Co.
Henry Valve Co.
Hoke, Inc.
Jenkins Bros.
Keckley Mfg. Co.
Kieley & Mueller
Klipfel Mfg. Co.
Leslie Co.
Manning, Maxwell & Moore
Mason-Neilan Regulator
McAlear Mfg.
Mercon Regulator
Northern Equipment
Powers Regulator Co.
Reynolds Gas Regulator
R-S Prod. Corp.
Schade Valve Mfg. Co.
Seely Inst. Co.
Sinclair-Collins Valve
Spence Engineering Co.
Swartwout Co.
Tagliabue Div.
Taylor Inst. Co.
Vapor Recovery Systems
Vaughn-G. E. Witt Co.
Watts Regulator Co.

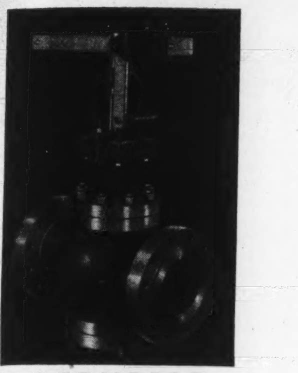
**VALVES, Diaphragm**

Adel Precision Products
Annin Co.
Askania Regulator Co.
Assoc. Valve & Engrg.
Atlas Valve Co.
Automatic Temp. Control
Bailey Meter Co.
Baldwin-Lima-Hamilton
Bastian-Blessing Co.
Boylston Co.
Bristol Co.
Cash Co.
Climax Div.
Conoflow Corp.
Continental Equip. Co.
Cook Electric
Davis Reg. Co.
Defender Inst. & Reg.
Eclipse-Pioneer Div.
Emmett Machine
Farris Engineering
Fischer & Porter
Fisher Governor
Flexible Valve Corp.
Foster Engg. Co.
Foxboro Co.
General Controls Co.
Gotham Inst. Co.
Hagan Corp.
Hammel-Dahl Co.
Henry Valve Co.
Hills-McCanna
Hoke, Inc.
Industrial Filter
Johnson Service Co.
Keckley Mfg. Co.
Kieley & Mueller
Klipfel Mfg. Co.
Laboratory Equipment
Ledeen Mfg.
Leslie Co.
Manning, Maxwell & Moore
Mason-Neilan Regulator
McAlear Mfg.
Mead Specialties Co.
Minneapolis-Honeywell
Natural Gas Equipment
North Amer. Mfg. Co.
Partlow Corp.
Paul Valve Co.
Powers Regulator Co.
Refrigerating Spec. Co.
Republic Flow Meters
Research Control Insts.
Reynolds Gas Regulator
Rockwell Mfg.
R-S Products Corp.
Schade Valve Mfg. Co.
Scientific Instrument Co.
Seely Inst. Co., Inc.
Sinclair Collins Valve
Spence Engineering Co.
Swartwout Co.
Tagliabue Div.
Taylor Inst. Cos.
Trerice Co.
Valvair Corp.
Vaughn-G. E. Witt
Watts Regulator
White-Rodgers Electric

**VALVES, Electrically Operated**

Adel Precision Prods.
Assoc. Valve & Engrg.
Atlas Valve Co.
Automatic Products Co.
Automatic Temp. Control
Baldwin Locomotive
Barber-Colman
Beck Co.
Bristol Co.
Brooke Engineering
Clark Cooper Co.
Cutler-Hammer, Inc.

(Continued)



**REPUBLIC REGULATING VALVES**

All Republic valves are engineered to the specific job on which they are used. Cylinder operated valves are available in sizes from 3 in. to 24 in. Hand operated valves in sizes from 1 in. to 8 in. Lever operated valves in sizes up to 16 inch.

Republic valves are built in all pressure standards — both flanged and welded ends. Streamlined flow through parts virtually eliminates erosion.

WRITE FOR DATA BOOK No. S-40

**REPUBLIC FLOW METERS CO.**
2240 Diversey Pkwy. Chicago 47, Ill.

**REPUBLIC INSTRUMENTS • CONTROLS**

Davis Reg. Co.
Defender Inst. & Reg.
Denison Engineering
Distillation Products
Electric Valve Mfg.
Flexible Valve Corp.
Foster Engg. Co.
Foxboro Co.
Frick Co.
Friez Instrument
General Controls Co.
General Electric Co.
Henry Valve Co.
Hills-McCanna
Jenkins Bros.
Keckley Mfg. Co.
Kieley & Mueller
Klipfel Mfg. Co.
Lear, Inc.
Leslie Co.
Magnatrol Valve Corp.
Manning, Maxwell & Moore
Marsh Corp., Jas. P.
Mason-Neilan Regulator
Minneapolis-Honeywell
North Amer. Mfg. Co.
Northern Equipment Co.
Paul Valve Co.
Penn Electric Switch
Perfex Corp.
Philadelphia Gear Works
Preferred Utilities
R-S Prod. Corp.
Schade Valve Mfg. Co.
Seely Inst. Co., Inc.
Shallcross Controls
Shallcross Mfg. Co.
Sinclair-Collins Valve
Spence Engineering Co.
Supreme Elec. Prods.
Tagliabue Div.
Wheelco Instruments
White-Rodgers Elec. Co.
Yellow Springs Inst. Co.

**VALVES, Hydraulically Operated**

Acme Industrial
Adel Precision
Annin Co.
Arca Regulators, Inc.
Askania Regulator
Assoc. Valve & Engrg.
Atlas Valve Co.
Auto. Temp. Control
Bailey Meter
Baldwin Locomotive
Barber Colman Co.
Cash Co.
Clark Cooper Co.
Conoflow Corp.
Continental Equip. Co.
Controls, Inc.
Defender Inst. & Reg.
Denison Engineering
(Continued)

Eclipse-Pioneer Div.
Farris Engineering
Fisher Governor
Flexible Valve Corp.
Ford Reg. Valve
Foster Engg. Co.
General Controls
General Electric Co.
General Regulator Corp.
Hagan Corp.
Hammel-Dahl Co.
Hays Corp.
Hills-McCanna
Hydraulic Controls, Inc.
Jenkins Bros.
Johnson Service Co.
Keckley Mfg. Co.
Kieley & Mueller
Ledeen Mfg.
Leslie Co.
Leupold & Stevens
Mason-Neilan Regulator
McAlear Mfg. Div.
North Amer. Mfg. Co.
Paul Valve Co.
Perfex Corp.
Philadelphia Gear Works
Powers Regulator Co.
Republic Flow Meter
Rockwell Mfg.
R-S Prod. Corp.
Schade Valve Mfg. Co.
Seely Inst. Co.
Shallcross Controls
Sinclair-Collins Valve
Shand & Jurs Co.
Spence Engineering
Sterling Eng. Co.
Sundstrand Machine Tool
Valvair Corp.
Vectron, Inc.
Waterman Eng. Co.

**VALVES, Lubricated Plug**

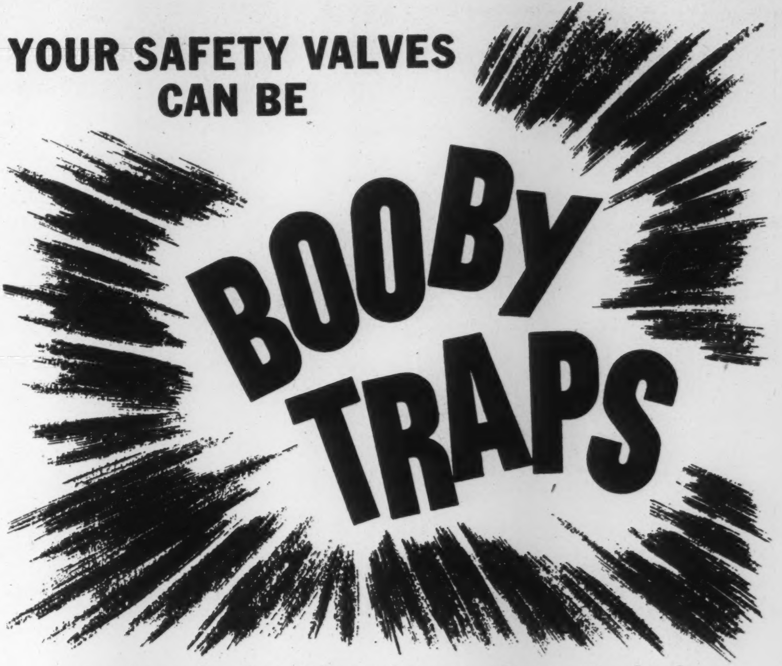
Acme Industrial
Clark Cooper Co.
Imperial Brass Mfg.
Industrial Filter
Parker Appliance
Rockwell Mfg.

**VALVES, Motor Operated (See Valves, Diaphragm; Valves, Electrically-operated; Valves, Hydraulically-operated; Valves, Solenoid)**

**VALVES, Pressure Relief, Reducing, etc.**

Acme Industrial
Adel Precision Prods.
American Meter Co.
Ashton Valve Co.
Askania Regulator Co.
Assoc. Valve & Engrg.
(Continued)

**YOUR SAFETY VALVES CAN BE**



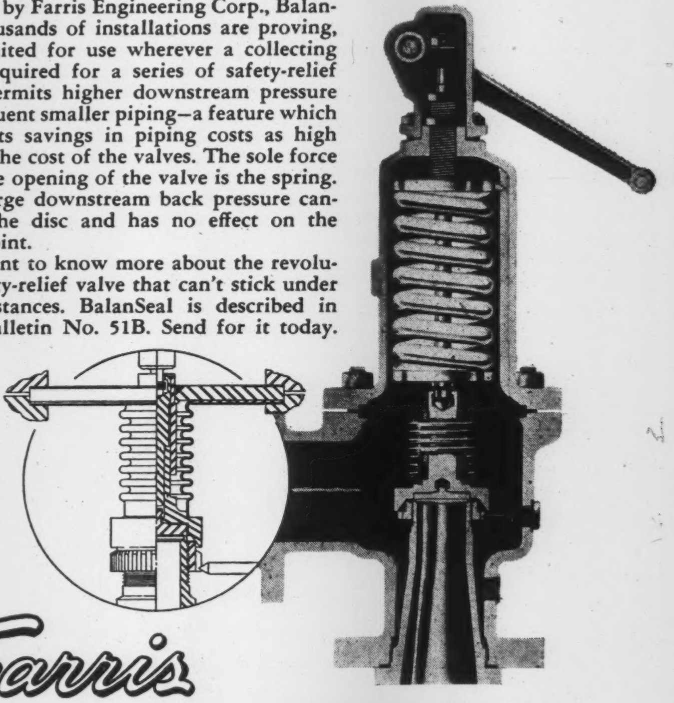
**A safety valve that sticks is about as safe as a time bomb**

Only BalanSeal© and FarriSeal© provide the positive protection at all times and under all operation conditions that makes them reliably safe.

Unique in design and principle, the BalanSeal Safety-Relief Valve has a protective bellows which is proportioned to eliminate any unbalanced downstream forces on the valve disc—which is perfectly balanced on its seat at the set pressure. Like its companion, the FarriSeal Valve, the guide, stem and spring are completely isolated from the lading fluid for perfect protection.

Pioneered by Farris Engineering Corp., BalanSeal, as thousands of installations are proving, is ideally suited for use wherever a collecting system is required for a series of safety-relief valves. It permits higher downstream pressure with consequent smaller piping—a feature which often permits savings in piping costs as high as 15 times the cost of the valves. The sole force opposing the opening of the valve is the spring. Static or surge downstream back pressure cannot affect the disc and has no effect on the relieving point.

You'll want to know more about the revolutionary safety-relief valve that can't stick under any circumstances. BalanSeal is described in detail in Bulletin No. 51B. Send for it today.



Patented and Patents Pending

Farris

**SAFETY and RELIEF VALVES**

FARRIS ENGINEERING CORP.
536 Commercial Avenue Palisades Park, N. J.

7983

*"Ours Measure Where Others Fail"*

MILLIVAC
DC-MICRO-VOLTMETER

Millivac vacuum tube meters are unusual measuring instruments which cover functions and ranges beyond those of ordinary vacuum tube meters.

**MV-11A DC micro-micro-ammeter, 10 uuA to 10 A DC**

**MV-15A DC microvolt meter, 0.5 uV to 1 V**

**MV-17B High impedance DC millivolt meter, 50 uV to 1,000 V**

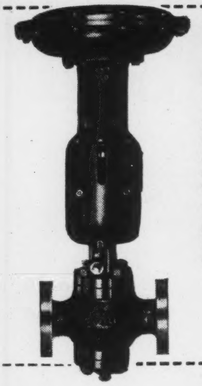
**MV-18B RF Millivolt meter, 1mV to 1,000 V, 1 MC to 2,500 MC**

**MV-73B Multi-meter, 10 mV to 1,000 V, AC, DC, RF, also 0.1 uA to 10 A, AC, DC, and 6 ohm ranges.**

Millivac meters feature highest sensitivity in conjunction with stability and minimum circuit loading. Our RF probes have input capacities down to 1.25 MMF. All instruments are available with change-over switch for operation of external meters and recorders. In addition, a complete line of Millivac electronic recorders features the well-known Sanborn heat-writing unit in combination with Millivac amplifiers.

Our Engineering Department will gladly assist you in solving unusual measuring problems. Write for our bulletins and free technical advice.

**Millivac Instrument Corporation**
**Box 997, Schenectady, N. Y.**



**HONEYWELL DIAPHRAGM MOTOR CONTROL VALVES**

• Compare the Honeywell Series "700" with any other wide band proportional control valve. Your comparison will prove it can't be matched for sensitivity, dependability and low maintenance. Available in a wide range of styles and sizes. The Honeywell line also includes liquid level controllers and diaphragm motor operators of both the spring and springless types.

Write for Catalog 700-2 for detailed information on diaphragm motor valves and Bulletin 750 for Control Valve Sizing Data. MINNEAPOLIS-HONEYWELL REGULATOR Co., *Industrial Division*, 4579 Wayne Ave., Philadelphia 44, Pa.

MINNEAPOLIS
**Honeywell**
*Valve Products*

Atlas Valve Co.
Autoclave Engineers
Bailey Meter Co.
Bastian-Blessing Co.
Bristol Co.
Brown & Sharpe
Cash Co.
Clark Cooper Co.
Climax Div.
Conoflow Corp.
**Crosby Steam Gage Co.**
Davis Reg. Co.
Eclipse-Pioneer Div.
Farris Engineering
Fisher Governor Co.
Ford Reg. Valve
Foster Engg. Co.
Foxboro Co.
Frick Co.
Fulton-Sylphon
General Controls
Gotham Inst. Co.
Grove Regulator
Hagan Corp.
Hammel-Dahl Co.
Henry Valve Co.
Hoke, Inc.
Instrument Repair & Mfg.
Johnston & Jennings Co.
Keckley Mfg. Co.
Kenyon Instrument Co.
Kieley & Mueller
Klipfel Mfg. Co.
Lammert & Mann Co.
Lear, Inc.
Leslie Co.
Lonergan Co.
Manning, Maxwell & Moore
Marsh Corp., Jas. P.
Mason-Neilan Regulator
McAlear Mfg.
Mead Specialties
Mercon Regulator
Minneapolis-Honeywell
Natural Gas Equipment
Northern Equipment
Parker Appliance
Powers Regulator Co.
Preferred Utilities
Republic Flow Meters
R-S Products Corp.
Ruska Inst. Corp.
Schade Valve Mfg. Co.
Seely Inst. Co., Inc.
Shand & Jurs Co.
Spence Engineering Co.
Swartwout Co.
Tagliabue Div.
Taylor Instr. Cos.
Trerice Co.
Vapor Recovery Systems
Victor Equipment Co.
Watts Regulator Co.

### VALVES, Proportional Air-Gas

American Meter Co.
Askania Regulator Co.
Automatic Temp. Control
Barber-Colman
Bristol Co.
Cash Co.
Cutler-Hammer, Inc.
Fisher Governor Co.
General Controls
Hagan Corp.
Hammel-Dahl Co.
Keckley Mfg. Co.
Lammert & Mann Co.
Mason-Neilan Regulator
North American Mfg.
Parker Appliance Co.
R-S Prod. Corp.
Tagliabue Div.
Trerice Co.

### VALVES, Regulating

Am. Gas Furnace Co.
American Meter Co.
Arca Regulators, Inc.
Askania Regulator Co.
Assoc. Valve & Engrg.
Atlas Valve Co.
Autoclave Engineers
Automatic Temp. Control
Bailey Meter Co.
**Barber Colman**
Bastian-Blessing Co.
Boylston Co.
Bristol Co.
Brooke Engineering

(Continued)

Cash Co.
Clarke Cooper Co.
Climax Div.
Conoflow Corp.
Cook Electric
Davis Reg. Co.
Defender Inst. & Reg.
Electronic Corp.
Erickson Specialty
Farris Stacon
Fischer & Porter
Fisher Governor Co.
Flexible Valve Corp.
Ford Reg. Valve Co.
Foster Engg. Co.
Foxboro Co.
Friez Instrument Div.
**Fulton Sylphon Div.**
General Controls Co.
Grove Regulator
Hagan Corp.
Hammel-Dahl Co.
Hannifin Mfg. Co.
Hoke, Inc.
Jenkins Bros.
Keckley Mfg. Co.
Kieley & Mueller
Klipfel Mfg. Co.
Lammert & Mann Co.
Leslie Co.
Manning, Maxwell & Moore
Mason-Neilan Regulator
McAlear Mfg. Div.
Mead Specialties Co.
Mercon Regulator
Minneapolis-Honeywell
Natural Gas Equipment
North Amer. Mfg. Co.
Northern Equipment Co.
Partlow Co.
Parr Inst. Co.
Podbielniak, Inc.
Powers Regulator Co.
Preferred Utilities
Republic Flow Meters
Robertshaw Thermostat
R-S Prod. Corp.
Rugka Inst. Corp.
Schade Valve Mfg. Co.
Seely Inst. Co., Inc.
Shallcross Controls
Spence Engineering Co.
Swartwout Co.
Tagliabue Div.
Taylor Inst. Cos.
Trerice Co.
Vapor Recovery Systems
Vaughn G. E. Witt
Waterman Engineering
Watts Regulator Co.
Wheelco Instruments

### VALVES, Safety Fuel Shutoff

American Meter Co.
Annin Co.
Askania Regulator Co.
Atlas Valve Co.
Automatic Products Co.
Automatic Switch Co.
Bastian-Blessing
**Bristol Co.**
Cash Co.
Clark Cooper Co.
Climax Div.
Continental Equip. Co.
Davis Reg. Co.
Eclipse Fuel Engg. Co.
Farris Engineering
Fisher Governor
Friez Instrument Div.
Fulton Sylphon Div.
General Combustion Corp.
General Controls Co.
Grove Regulator
Hammel-Dahl Co.
Henry Valve Co.
Keckley Mfg. Co.
Kieley & Mueller
Leslie Co.
Lonergan Co.
Manning, Maxwell & Moore
Mason-Neilan Regulator
Milwaukee Gas Specialty
Minneapolis-Honeywell
Natural Gas Equipment
North Amer. Mfg. Co.
OPW Corp.
Partlow Corp.
Penn Electric Switch

(Continued)

Phillips Petroleum
Preferred Utilities Mfg.
R-S Products
Schade Valve Mfg. Co.
Seely Inst. Co., Inc.
Spence Engineering Co.
Tagliabue Div.
Vapor Recovery Systems
Viking Instrument Co.
Wheelco Instruments

### VALVES, Solenoid

Adel Precision Prods.
Annin Co.
Assoc. Valve & Engrg.
Atlas Valve Co.
Automatic Products Co.
Automatic Temp. Control
Baldwin-Lima-Hamilton
Barber-Colman Co.
Clark Cooper Co.
Continental Equip. Co.
Cook Electric
Cutler-Hammer, Inc.
Davis Reg. Co.
Denison Engineering
Distillation Products
Emmett Machine
Erickson Specialty
Foxboro Co.
Frick Co.
Friez Instrument Div.
General Controls Co.
General Electric Co.
Gleason-Avery, Inc.
Gordon Co., Claud. S.
Grove Regulator
Guardian Elec. Mfg.
Hannifin Mfg. Co.
Hays Corp.
Henry Valve Co.
Hills-McCanna
Instrument Dev. Labs.
Kieley & Mueller
Leslie Co.
Magnatrol Valve Corp.
Marsh Corp., Jas. P.
Minneapolis-Honeywell
Northern Equip. Co.
Partlow Corp.
Paul Valve Co.
Perfex Corp.
Preferred Utilities
R-S Prod. Corp.
Sampsel Time Control
Schade Valve Mfg. Co.
Schwien Engr.
Seely Inst. Co., Inc.
Shallcross Controls
Sinclair Collins Valve
Skaneateles Mfg. Co.
Spencer Engineering Co.
Sterling Eng. Co.
Sundstrand Machine Tool
Tagliabue Div.
Taylor Inst. Cos.
Valvair Corp.
Wheelco Instruments
White Rodgers Elec.
Yellow Springs Instrument

### VALVES, Thermostat (See Thermostats)

### VAR METERS (See Volt-ampere Meters, Reactive)

### VEHICLE TRAVEL RECORDERS

Commercial Research
Cramer & Co.
Elec. Tachometer Corp.
Knopf Instrument
Service Recorder Co.
Speedometer Electric
U. S. Taximeter

### VENTURI METERS (See Flowmeters, Venturi)

### VENTURI TUBES (See Flowmeters, Venturi)

### VIBRATION ISOLATORS (See Mountings)

### VIBRATION PICKUPS

Amperite Co.
Baldwin-Lima-Hamilton
Brush Development
Calidyne Co.
Commercial Research
Consolidated Engg.
Crystal Research Labs.
Boekel & Co.

(Continued)

Electro Prod. Labs.
Engineering Res. & Dev.
Flader Inc., Fredric
General Electric
General Radio Co.
Geophysical Inst. Co.
Haines Designed Prod.
Hathaway Inst. Co.
Heiland Research
Lion Mfg., Inc.
Massa Laboratories
M B Mfg. Co.
Minnesota Electronics
Phillips Petroleum
Schaevitz Engineering
Scott Inc., Hermon
Sperry Gyroscope Co.
Statham Labs.
Van Dyke Instruments
Westinghouse Elec.
Wiancko Engineering

### VIBOGRAPHS

Baldwin-Lima-Hamilton
Cambridge Inst. Co.
Central Scientific Co.
Chicago Apparatus Co.
Commercial Research
Heiland Research
Impact Register Co.
RCA Div.
Ruska & Co.
Vibration Specialty
Westinghouse Elec.

### VIBROMETERS

Aircraft Electronics
American Inst. Co.
Associated Research
Consolidated Engg.
Electrocon Corp.
General Electric
General Radio Co.
Haines Designed Prod.
Hathaway Instrument
Heiland Research
Martin-Hubbard Corp.
Massa Laboratories
M. B. Mfg. Co.
Potter Co.
Sticht Co.
Van Dyke Instruments
Vibration Specialty
Walkirt Co.
Westinghouse Elec.

### VIBROSCOPES

Aircraft Electronics
Amperite Corp.
Brush Development
Century Geophysical
Coleman Instrument
Commercial Engg. Labs.
Electro Products Labs.
General Elec. Co.
Heiland Research Corp.
Humboldt Mfg. Co.
Massa Laboratories
M. B. Mfg. Co.
Varo Mfg. Co.

### VICAT NEEDLES (See Needles Vicat)

### VISCOSIMETER BATHS, Constant-temperature

American Inst. Co.
Brabender Corp.
Braun Corp.
Central Scientific Co.
Coleman Inst. & Reg.
Eitzen Co.
Electric Hotpack Co.
Fish-Schurman Corp.
Fisher Scientific Co.
Humboldt Mfg. Co.
Koehler Instrument
Modern Electrical Lab.
Precision Scientific Co.
Process & Instruments
Ruska Instrument
Sargent & Co., E. H.
Scientific Glass App.
Tenney Engr.
Thomas Co., Arthur H.
Thwing-Albert

### VISCOSIMETER, Brookfield

Brookfield Eng. Labs.

### VISCOSIMETERS, Engler

American Inst. Co.

(Continued)

Central Scientific Co.
Hiergesell & Sons
Humboldt Mfg. Co.
Kimble Glass
Precision Scientific Co.
Ruehfel Co.

**VISCOSIMETERS, Fenske**
American Inst. Co.
Fisher Scientific Co.
Humboldt Mfg. Co.
Kimble Glass
Phoenix Prec. Inst.
Precision Scientific

**VISCOSIMETERS, Ford (For Paint)**
Central Scientific Co.
Humboldt Mfg. Co.
Koehler Instrument Co.
Scientific Inst. Co.

**VISCOSIMETERS, Hoeppler**
Central Scientific Co.
Fish-Schurman Co.
Phoenix Prec. Inst.
Precision Scientific
Sargent & Co.

**VISCOSIMETERS, Kinematic**
American Inst. Co.
Braun Corp.
Fischer & Porter
Fisher Scientific Co.
Hiergesell & Sons
Koehler Instrument
Precision Scientific Co.

**VISCOSIMETERS, MacMichael**
Fisher Scientific Co.

**VISCOSIMETER (For Plastic Flow Fluids)**
Doelcam Corp.
Norcross Corp.
Southwestern Ind. Elec.

**VISCOSIMETERS, Recording**
Brabender Corp.
Brookfield Engg. Labs.
Coleman Inst. & Mfg.
Doelcam Corp.
Fischer & Porter
Hayes Scientific App.
Norcross Corp.
Precision Scientific

**VISCOSIMETERS, Redwood**
American Inst. Co.
Hiergesell & Sons
Ruehfel Co.

**VISCOSIMETERS, Saybolt**
American Inst. Co.
Boekel & Co.
Central Scientific Co.
Corning Glass Works
Eitzen Co.
Fisher Scientific
Hiergesell & Sons
Humboldt Mfg. Co.
Kimble Glass Co.
Monarch Mfg. Wks.
Precision Scientific Co.
Ruehfel Co.
Zuhr, Inc., Henry

**VISCOSIMETERS, Scott**
Boekel & Co.
Central Scientific Co.
Hiergesell & Sons
Precision Scientific Co.
Ruehfel Co.
Sargent & Co.
Scott Testers

**VISCOSIMETERS, Stormer**
Aloe Co., A. S.
Central Scientific Co.
Hiergesell & ons
Industro-Scientific Co.
Thomas Co., Arthur H.

**VISCOSIMETERS, Ubbelhode**
American Inst. Co.
Boekel & Co.
Central Scientific Co.
Fish-Schurman Co.
Fisher Scientific
Hiergesell & Sons
Precision Scientific Co.
Sargent & Co.

**VISCOSIMETERS, Zahn**
General Elec. Co.
Precision Scientific

**VISCOSITY GAGES**
Gerin Corp.

**VISCOSITY REGULATORS (See Controllers, Automatic, Viscosity**

**VISCOSITY TUBES**
Cargille, R. P.
Eitzen Co.
Fischer & Porter
Gardner Laboratory
Fish-Schurman Co.
Humboldt Mfg. Co.
Koehler Instrument
Phoenix Prec. Inst.
Precision Scientific

**VOLTAGE ADJUSTERS, AUTOMATIC**
Amplifier Co.
General Elec. Co.
Ideal Commutator Dresser
Lewis Co., J. B.
Rockwell Engr.
Sherron Metallic
Sola Electric Co.
Sorensen & Co.

**VOLTAGE DETECTORS (See Detectors, Voltage)**

**VOLTAGE DIVIDERS, Radio Frequency (See Dividers, Voltage)**

**VOLTAGE, HIGH (above 2300 volts) Indicators**
Ballantine Labs.
Bradshaw Instruments
Cole Instrument
Dale Instruments
Feiler Engineering
General Elec. Co.
General Physical Lab.
Ideal Commutator Dresser
Leeds & Northrup Co.
Meters, Inc.
Precision Apparatus
Rawson Electrical Inst.
Roller-Smith
Sensitive Research Inst.
Shallcross Mfg. Co.
Sherron Metallic
Triplett Electrical Inst.
Westinghouse Elec.
Weston Elec. Inst. Corp.

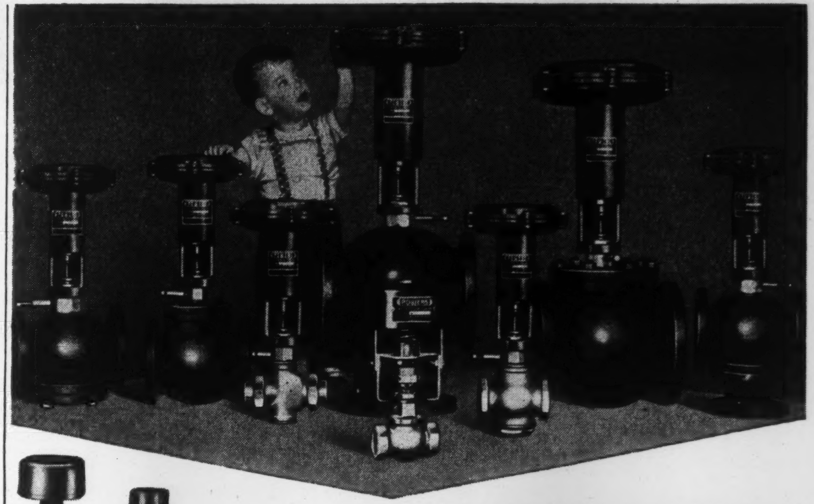
**VOLTAGE, HIGH (above 2300 volts) Measuring Devices**
Associated Research
Ballantine Labs.
Barber Labs., Alfred
Bradshaw Instruments
Cole Instrument
Electronic Instrument
Feiler Engineering
Ferranti Electric
Freed Transformer
Fox Valley Inst.
General Elec. Co.
International Resistance
Leeds & Northrup
Meters, Inc.
Precise Measurements
Precision Apparatus
Radio City Products
Rawson Elec. Inst. Co.
Reiner Electronics
Roller-Smith
Sensitive Research Inst.
Shallcross Mfg.
Sherron Metallic
Triplett Elec. Inst.
Westinghouse Elec.
Westinghouse X-Ray Co.
Weston Elec. Inst. Corp.

**VOLTAGE, HIGH (above 2300 volts) Testing Devices**
American Transformer
Associated Research
Bradshaw Instruments
Cole Instrument
Electronic Instrument
Feiler Engineering
General Elec. Co.
Industrial Insts., Inc.
International Resistance
MacLeod & Hanopol
Miller Co., Bertrand F.
Precise Measurements
Precision Apparatus
Radio City Products
Raytheon Mfg. Co.
Reiner Electronics
Roller-Smith Co.
S & C Electric
Sensitive Research Inst.
Shallcross Mfg. Co.
Sherron Metallic
Simpson Electric
States Co.
Superior Elec. Co.
Thordarson Elec. Mfg.
Triplett Elec. Inst.
Westinghouse Elec.
Weston Elec. Inst. Corp.

**VOLTAGE REGULATORS (See Regulators, Automatic, Voltage)**

**VOLTAGE SUPPLIES (See Power Supplies)**

**VOLT-AMMETERS**
Am. Elec. Sales Co.
Assembly Products
Associated Research, Inc.
Bradshaw Instruments
Beckman Instruments
Burlington Inst. Co.
Clough-Brengle Co.
Cole Instrument
Dale Instruments
De Jur Amsco Corp.
Electro-Tech Equip. Co.
Electronic Dev. Lab.
Electronic Instrument
Esterline-Angus Co.
Feiler Engineering
Fox Valley Inst.
General Elec. Co.
Hickok Elec. Inst. Co.
International Instrument
Lewis Engineering
Meters, Inc.
Precision Apparatus Co.
Radio City Products
RCA Div.
Rawson Electrical Inst.
Reiner Electronics
Reliance Instrument Co.
Roller-Smith Co.
Sangamo Electric
Schauer Mfg. Co.
Sendur Mfg.
Sensitive Research Inst.
Simpson Electric Co.
Sticht Co.
Supreme Instruments
Triplett Electrical Inst.
U. S. Gauge
Welch Scientific
Westinghouse Elec.
Weston Elec. Inst. Corp.
Wheelco Instrument

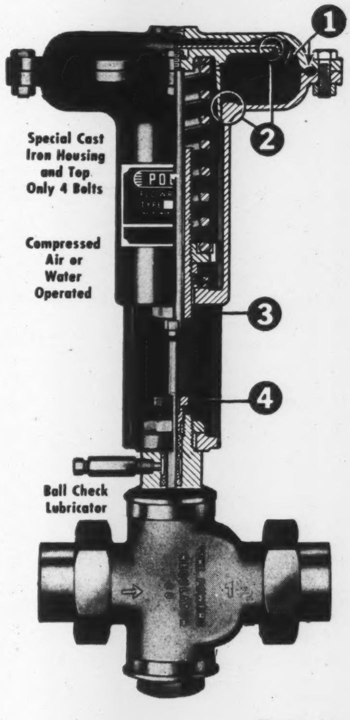


Two of many different styles of pneumatic control valves for radiators, convectors and air conditioning units.

POWERS

FLOWRITE DIAPHRAGM VALVES

Insure BETTER Control and Extra Years of Dependable Service


1
2
Special Cast Iron Housing and Top Only 4 Bolts
Compressed Air or Water Operated
3
4
Ball Check Lubricator
POWERS

**Compressed Air or Water Operated**

**VALVE TOP**—Durable moulded neoprene diaphragm (1) has positive sealing bead which provides increased sealing action with increasing control pressure. Efficient diaphragm form insures ample and constant operating power thru full travel. Piston Plate Assembly (2) has a free floating thrust plate which absorbs side thrust. Closely guided piston plate maintains stem in accurate alignment.

**Adjustment Screw (3)**—Ball bearing nonrising type with starting pressure adjustable from 0 to 17 psi. Has enclosed rust proofed steel spring for full travel in 5 or 10 psi. control pressure change.

**Bonnet Assembly (4)**—Polished stainless steel stem in preformed lubricated metallic packing insures long life and low hysteresis.

**VARIETY of VALVE BODIES and TRIM Sizes ½" thru 8"** —For line pressure up to 250 lbs. per square inch. Rugged construction to withstand piping strains. Single seat Stainless Steel V-Port, or double seat, bronze and stainless steel trim. Double unions and flanged ends. Available normally open (direct acting) or normally closed (reverse acting) and 3-way mixing type valves.

**Phone nearest office for prices.**

**THE POWERS REGULATOR COMPANY**

***60 Years of Temperature and Humidity Control***

**Offices in Over 50 Cities—See Your Telephone Directory**

**Factory and General Offices: 3434D Oakton St., Skokie, Ill.**

Simpson
INSTRUMENTS THAT STAY ACCURATE

LET SIMPSON ENGINEERS HELP YOU SOLVE YOUR INSTRUMENT PROBLEMS

Back of every Simpson product is the combined and co-ordinated abilities of the industry's finest design engineers, outstanding production experts and highly skilled technical workmen. Every Simpson instrument is outstanding for greater ruggedness and accuracy, because of the full bridge-type construction and soft iron pole pieces.

*Manufacturers of*

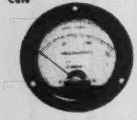
PANEL AND SWITCHBOARD INSTRUMENTS • AC MOVING VANE TYPE • PERMANENT MAGNET TYPE • AC RECTIFIER TYPE • THERMOCOUPLE TYPE • DYNAMOMETER TYPE • PANEL WATTMETERS • CASE SIZES RANGE AS FOLLOWS: 1½"-2½"-3½"-4½"-7"-9" IN MOST MODELS

ALSO COMPLETE LINE OF RADIO, TELEVISION AND ELECTRONIC TESTING EQUIPMENT

*A Clear, Readable Dial in* DARK *or Daylight*
SIMPSON ILLUMINATED DIAL PANEL METERS

**Model 26**—D.C., Model 56—A.C., Model 36—R.F. 3½" Round Instrument, Bakelite Case.

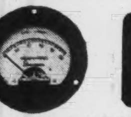
**Model 27**—D.C., Model 57—A.C., Model 37—R.F. 3" Rectangular Instrument, Bakelite Case



**Model 25**—D.C., Model 55—A.C. 3½" Round Instrument, Bakelite Case

**Model 29**—D.C., Model 59—A.C., Model 39—R.F. 4½" Rectangular Instrument, Bakelite Case

**Model 126**—D.C., Model 156—A.C. 2½" Round Instrument, Bakelite Case



**Model 125** — D. C., Mode 155—A.C. 2½" Round Instrument, Bakelite Case

**Model 127**—D.C., Model 157—A.C. 2" Rectangular Instrument, Bakelite Case

**Model 180** — Direct Current only. 1½" Threaded Ring Mounting Type, Bakelite Case

WORLD FAMOUS
*Model 260*
VOLT OHM-MILLIAMMETER

**There are more Simpson 260 high sensitivity volt-ohm-milliammeters in use today than all others combined.**

RANGES

Model 260 Volt-Ohm-Milliammeter 20,000 Ohms per Volt DC, 1,000 Ohms per Volt AC. Volts, AC and DC: 2.5, 10, 50, 250, 1000, 5000. Output: 2.5, 10, 50, 250, 1000. Milliamperes, DC: 10, 100, 500. Microamperes, DC: 100. Amperes, DC: 10. Decibels (5 ranges): —12 to+55 DB. Ohms: 0-2000 (12 ohms center), 0-200,000 (1200 ohms center), 0-20 megohms. (120,000 ohms center).

*New!* SIMPSON 303 VACUUM TUBE VOLT-OHMMETER

The 303 can be used as an electronic DC voltmeter, an ohmmeter, an AC voltmeter, an AF voltmeter, an RF voltmeter (with accessory probe), an outputmeter and an FM indicator; 60 to 70% more compact than any similar instrument. Low current consumption, wide voltage and resistance ranges make it an extremely versatile instrument.

SPECIFICATIONS

**DC VOLTAGE:** Ranges—1.2, 12, 60, 300, 1200 (30,000 with Accessory High Voltage Probe). Input Resistance—10 megohms for all ranges. DC Probe—with one megohm isolating resistor. Polarity reversing switch. **OHMS:** Ranges—1000 (10 ohm center). 100,000 (1000 ohms center). 1 megohm (10,000 ohms center) 10 megohms (100,000 ohms center). 1000 megohms (10 megohms center). **AC VOLTAGE:** Ranges—1.2, 12, 60, 300, 1200. Impedance (with cable) approx. 200 mmf shunted by 275,000 ohms. **AF VOLTAGE:** Ranges—1.2, 12, 60. Frequency Response—Flat 25 to 100,000 cycles. **DECIBELS:** Ranges— —20 to +3, —10 to +23, +4 to +37, +18 to +51, +30 to +63. Zero Power Level—1 M. W., 600 ohms. **GALVANOMETER:** Zero center for FM discriminator alignment and other galvanometer applications. **R. F. VOLTAGE:** (Signal tracing with Accessory High Frequency Crystal Probe). Range—20 volts maximum. Frequency—Flat 20 KC to 100 M.C. **LINE VOLTAGE:** 105-125 V. 50-60 cycles. **SIZE:** 5¼"x7"x 3⅛" (bakelite case). Weight: 4 lbs. Shipping Wt.: 6⅛ lbs.

SIMPSON ELECTRIC COMPANY
5200-5218 W. KINZIE STREET, CHICAGO 44, ILL
COL 1-1221
*In Canada: Bach-Simpson, Ltd., London, Ontario*

RAWSON METERS

MULTIMETERS and REGULAR METERS
AC and DC types, high accuracy, multiple ranges.
2 microamperes to 1 ampere DC.
2 milliamperes to 3 amperes AC.

ELECTROSTATIC VOLTMETERS
Ranges 100-v. to 35,000-v. AC or DC Resistance exceeds million megohms. Can measure static electricity.

FLUXMETERS
Laboratory and production measurements on magnets and magnetic circuits. Single push button return-to-zero.

ROTATING COIL GAUSSMETER
Our most recent development for measuring magnetic field strengths. Measures from a few gausses to 120 kilogausses.

Special apparatus built to order
Write for details and estimates

RAWSON ELECTRICAL INSTRUMENT COMPANY
112-b Potter St. Cambridge, Mass.
REPRESENTATIVES
CHICAGO LOS ANGELES

**VOLT-AMPERE-HOUR METERS**

Ferranti Electric, Inc.
General Electric Co.
Minneapolis-Honeywell
Roller-Smith
Sangamo Electric
Westinghouse Elec.

**VOLT-AMPERE METERS, REACTIVE**

Cole Instrument
Electrical Facilities, Inc.
Esterline-Angus Co.
General Elec. Co.
Hickok Elec. Instrument
Landis & Gyr, Inc.
Sangamo Electric
Sensitive Research Inst.
Triplett Elec. Inst.
Westinghouse Elec.
Weston Elec. Inst.

**VOLTMETERS, A-c. Rectifier**

Ballantine Labs.
Bradshaw Instruments
Burlington Instrument
Dale Instruments
De Jur-Amsco Corp.
Dittmore & Freimuth
Electronic Instrument
Feiler Engineering
General Electric Co.
General Radio Co.
Hewlett-Packard
International Instrument
Marion Electrical Inst.
Meters, Corp.
Roller-Smith
Sendur Mfg.
Simpson Electric Co.
Sterling Mfg. Co.
Triplett Elec. Inst.
U. S. Gauge Co.
Welch Scientific
Westinghouse Elec.
Weston Elec. Inst. Corp.

**VOLTMETERS, Contact Making**

Assembly Products
De Jur-Amsco
Cole Instrument
Edison Electrical Controls
Electric Des. & Mfg.
Electric Laboratory
Electric Tachometer Corp.
Electronic Development
Engineering Labs., Inc.
Esterline-Angus Co.
Ferranti Electric, Inc.
General Electric Co.
Geophysical Instrument Co.
Hickok Electrical Inst.

(Continued)

Lewis Engineering
Reliance Instrument Co.
Roller-Smith Co.
Triplett Elec. Inst.
Weston Electrical Inst.
Wheelco Instrument

**VOLTMETERS, Electrostatic**

Assembly Products
Cambridge Inst. Co.
Cole Instrument
Dittmore & Freimuth
Ferranti Electric, Inc.
General Elec. Co.
Hathaway Inst. Co.
Hickok Elect. Inst. Co.
Minnesota Electronics
Rawson Electrical Inst.
Sensitive Research Inst.
Sticht Co.

**VOLTMETERS, Indicating**

Assembly Products
Associated Research
Ballantine Labs.
Beede Elec. Instrument
Burlington Inst. Co.
Chicago Indust. Inst.
Clough-Brengle Co.
Cole Instrument
Columbia Elec. Mfg.
Control Corp.
Dale Instruments
De Jur-Amsco Corp.
Dittmore & Freimuth
Electric Des. & Mfg.
Electronic Development
Feiler Engineering
Ferranti Electric, Inc.
General Elec. Co.
Hickok Elec. Inst. Co.
International Instrument
J-B-T Insts.
Kay Electric
Lewis Engineering
Marion Electrical Inst.
Meters, Inc.
Miller, M. C.
Minnesota Electronics
Niagara Electrical Inst.
Precision Apparatus Corp.
Radio City Products Co.
Rawson Electrical Inst.
RCA Manufacturing Co.
Reiner Instrument
Reliance Instrument
Roller-Smith Co.
Sendur Mfg.
Sensitive Research Inst.
Shelby Inst.
Sierra Electronic
Simpson Elec. Co.
Sterling Mfg. Co.
Sticht Co.

(Continued)

Sun Electric Corp.
Taco West Corp.
Triplett Elec. Inst.
Triumph Mfg. Co.
U. S. Gauge
Welch Scientific
Westinghouse Elec.
Weston Elec. Inst. Corp.
Wheelco Instrument
Winslow Co.

**VOLTMETERS, Laboratory Standard**

Ballantine Labs.
Beckman Instruments
Burlington Instrument
Electronic Instrument
Feiler Engineering
Ferranti Electric
General Electric Co.
Measurements Corp.
Rawson Elec. Inst.
Roller-Smith Co.
Sensitive Research Inst.
U. S. Gauge Co.
Welch Scientific
Weston Elec. Inst. Corp.

**VOLTMETERS, Megohm**

Assembly Products
Beckman Instruments
Beede Elec. Instrument
Cole Instrument
Dale Instruments
Daven Co.
Delmhorst Instrument
Electro Products Lab.
Electro-Tech. Equip. Co.
Electronic Dev. Lab.
Feiler Engineering
General Radio Co.
Hickok Elect. Inst. Co.
Industrial Control Co.
Industrial Insts. Inc.
Jackson Electrical Inst.
Precision Apparatus
Rawson Electrical Inst.
RCA Div.
Sensitive Research Inst.
Shallcross Mfg. Co.
Sticht Co.
Sun Manufacturing
Triplett Elec. Inst.
Welch Scientific
Westinghouse Elec.
Weston Elec. Inst. Corp.

**VOLTMETERS, Micro**

Ballantine Labs.
Cambridge Inst. Co.
Cole Instrument
Dale Instruments
De Jur-Amsco Corp.
Dittmore & Freimuth
General Electric Co.
General Radio Co.

(Continued)

Hickok Elec. Inst. Co.
Industrial Control Co.
Microvolts, Inc.
Rawson Electrical Inst.
Sensitive Research Inst.
Supreme Instruments
Televiso Co.
Triplett Elec. Inst.
Welch Scientific
Weston Elec. Inst. Corp.
Wheelco Inst. Co.

**VOLTMETERS, Micro, Radio Frequency**

Ballantine Labs.
Burlington Inst. Co.
Clarke Inst. Corp.
Cole Instrument
Electric Des. & Mfg.
Feiler Engineering
Ferris Inst. Corp.
General Elec. Co.
General Radio Co.
Hickok Elec. Inst. Co.
Rollin Co.
Sensitive Research Inst.
Sylvania Elec. Prods.
Triplett Elec. Inst.

**VOLTMETERS, Millivoltmeters**

Assembly Products
Ballantine Labs.
Beckman Instruments
Bristol Co.
Brown Instrument Div.
Burlington Inst. Co.
Cambridge Inst. Co.
Cole Instrument
Commercial Research
Dale Instruments
De Jur-Amsco Corp.
Dittmore & Freimuth
Electric Des. & Mfg.
Electronic Development
Engelhard, Chas.
Esterline-Angus Co.
Feiler Engineering
Foxboro Co.
Freed Transformer
General Elec. Co.
Hickok Elec. Inst. Co.
International Instrument
J-B-T Insts.
Lewis Engineering
Marion Electrical Inst.
Meters, Inc.
Miller, M. C.
Millivac Instruments
Radio-City Products Co.
Rawson Electrical Inst.
RCA Manufacturing
Reiner Electronics
Reliance Instrument
Roller-Smith
Sensitive Research Inst.

(Continued)

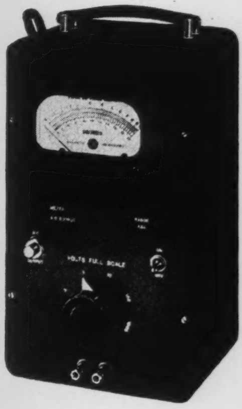
# BALLANTINE

## STILL THE FINEST IN ELECTRONIC VOLTMETERS

**MODEL 300**

**MODEL 302B**

**MODEL 304**



**MODEL 305**

**MODEL 310A**

| MODEL | FREQUENCY RANGE | VOLTAGE RANGE | INPUT IMPEDANCE | ACCURACY |
|---|---|---|---|---|
| 300 | 10 to 150,000 cycles | 1 millivolt to 100 volts | 1/2 meg. shunted by 30 mmfds. | 2% up to 100 KC<br>3% above 100 KC |
| 302B Battery Operated | 2 to 150,000 cycles | 100 microvolts to 100 volts | 2 megs. shunted by 8 mmfds. on high ranges and 15 mmfds. on low ranges | 3% from 5 to 100,000 cycles; 5% elsewhere |
| 304 | 30 cycles to 5.5 megacycles | 1 millivolt to 100 volts except below 5 K C where max. range is 1 volt | 1 meg. shunted by 9 mmfds. on low ranges. 4 mmfds. on highest range | 3% except 5% for frequencies under 100 cycles and over 3 megacycles and for voltages over 1 volt |
| 305 | Measures peak values of pulses as short as 3 microseconds with a repetition rate as low as 20 per sec. Also measures peak values for sine waves from 10 to 150,000 cps. | 1 millivolt to 1000 volts Peak to Peak | Same as Model 302B | 3% on sine waves<br>5% on pulses |
| 310A | 10 cycles to 2 megacycles | 100 microvolts to 100 volts | Same as Model 302B | 3% below 1 MC<br>5% above 1 MC |

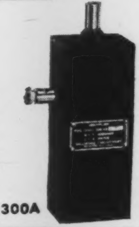
**MODEL 220A**
**BATTERY OPERATED DECADE AMPLIFIER** gives exact voltage gains of 10 or 100, permitting a corresponding increase in voltmeter sensitivity from 10 to 150,000 cycles.

**PRECISION SHUNT RESISTORS**

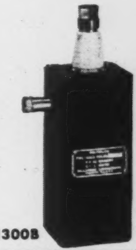
Four different types of Precision Shunt Resistors, varying from 1 to 1000 ohms, permit the Voltmeters to be used to measure currents from 1 ampere to one-tenth of a microampere.

**MULTIPLIERS**

Five different types of Multipliers, whose input resistance varies from 5 to 40 megohms, permit the voltage range of the Voltmeters to be increased 10 or 100 times.



**1300A**



**1300B**

**BALLANTINE pioneered circuitry and manufacturing integrity assure the maximum in**

***SENSITIVITY • ACCURACY • STABILITY***

- All models have a single easy-to-read logarithmic voltage scale and a uniform DB scale.
- The logarithmic scale assures the same accuracy at *all* points on the scale.
- Multipliers, decade amplifiers and shunts shown above extend range and usefulness of voltmeters.
- Each model may also be used as a wide-band amplifier.

*For further information, write for catalog*

**BALLANTINE LABORATORIES, INC.**

112 FANNY ROAD, BOONTON, NEW JERSEY

-COLE-
INSTRUMENTS

DIRECT CURRENT
MILLIAMPERES
COLE

**Panel Type Electrical Instruments**

furnished with round or square cases in standard and special ranges.

**Portable Electrostatic Voltmeters**

available in all high ranges in single and multiple scales.

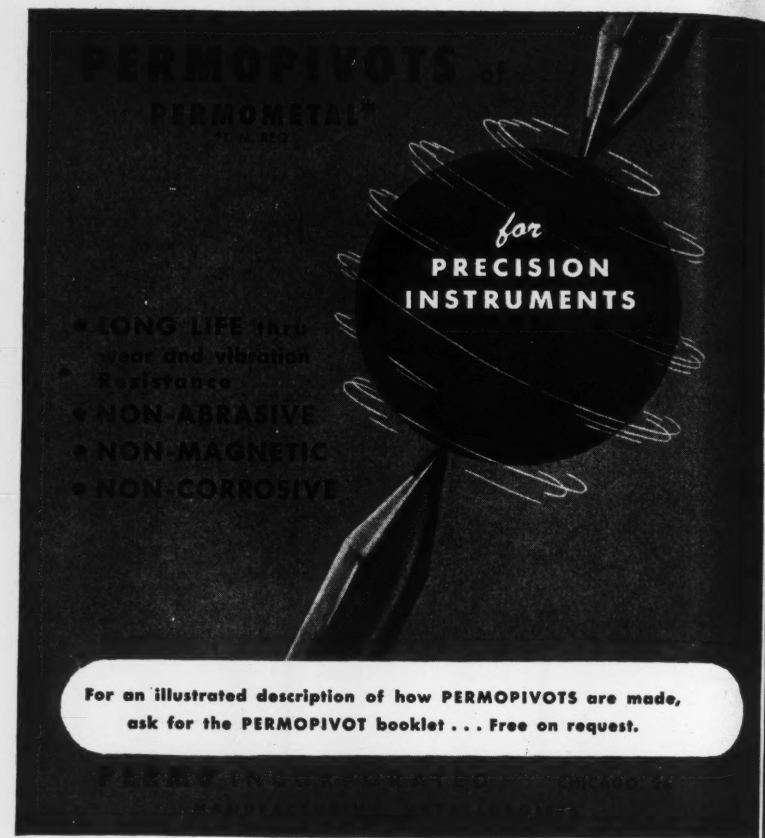
Case style shown above also available in Portable Precision Electrical Instruments and Portable Precision Pyrometers.

**Other Cole Products**

- Pyrometers—Portable and Mounted Types
- Long Scale spot-of-light pointer type instruments
- Industrial Analyzers
- Aircraft Electrical System Testers
- Megohmmeters
- Insulation Testers
- Phase Sequence Indicators
- Decade Boxes
- Selector Switches
- Current Transformers
- Shunts • Resistors
- Potentiometers

*Ask for Complete Catalog*

**COLE Instrument Co.**
1320 S. Grand Ave., Los Angeles 15, Calif.



For an illustrated description of how PERMOPIVOTS are made, ask for the PERMOPIVOT booklet . . . Free on request.

PERMO INCORPORATED CHICAGO 26

Shallcross Mfg. Co.
Sierra Electronic
Simpson Elec. Co.
Southwestern Ind. Elec.
Standard Science Sup.
Sun Manufacturing
Taco West Corp.
Thwing-Albert Inst. Co.
Triplett Electrical Inst.
Welch Scientific
Westinghouse Elec.
Weston Elec. Inst. Corp.
Wheelco Inst. Co.

**VOLTMETERS, Millivoltmeters, A-c, Rectifier**

Ballantine Laboratories
Beckman Instruments
Burlington Instruments
Dale Instruments
De Jur-Amsco Corp.
Dittmore & Freimuth
Electronic Development
Electronic Instrument
Feiler Engineering
General Electric
Hewlett-Packard
International Instruments
Marion Electrical Inst.
Prec. Apparatus Co.
Roller-Smith Co.
Triplett Elec. Instrument
Welch Scientific
Westinghouse Elec.
Weston Elec. Inst. Corp.

**VOLTMETERS, Oxide Rectifier**

Assembly Products
Clough-Brengle Co.
Cole Instrument
Dale Instruments
De Jur-Amsco Corp.
Electric Des. & Mfg.
Electronic Dev. Lab.
Feiler Engineering
General Elec. Co.
General Radio Co.
Hickok Elec. Inst. Co.
Marion Electrical Inst.
Meters, Inc
Precision Apparatus
Radio City Products Co
Reiner Electronics
Reliance Instrument
Roller-Smith
Simpson Elec Co.
Sun Manufacturing
Supreme Instruments
Taco West Corp.
Triplett Electrical Inst.
Triumph Mfg. Co.
Welch Scientific
Westinghouse Elec.
Weston Elec. Inst. Corp.
Hickok Elec. Inst. Co.

**VOLTMETERS, Peak**

Ballantine Labs.
Barber Labs., Alfred
Clarke Inst. Corp.
Clough-Brengle Co.
Cole Instrument
Electronic Dev. Lab.
Feiler Engineering
Fox Valley Inst.
General Elec. Co.
General Radio Co.
Hickok Elec. Inst. Co.
Kay Electric
Measurements Corp.
Rawson Elec. Instrument
RCA Mfg. Co.
Rowe Engineering
Sensitive Research Inst.
Simpson Elec.
Triplett Elec. Inst.

**VOLTMETERS, Recording**

Alfax Paper & Engrg.
Bristol Co.
Brush Development
Cambridge Inst. Co.
Cole Instrument
Engelhard, Chas.
Esterline-Angus Co.
Fielden Instrument
General Elec. Co.
Leeds & Northrup Co.
Massa Labs.
Precise Measurements Co.
Roller-Smith
Sanborn Co.
Southwestern Ind. Elec.
Sound Apparatus
Sticht Co.
Westinghouse Elec.
Wheelco Instrument

**VOLTMETERS, Thermionic Rectifier**

Ballantine Labs.
Barber Labs., Alfred
Cambridge Inst. Co.
Clippard Inst. Lab.
Cole Instrument
Electronic Dev. Lab.
General Elec. Co.
General Radio Co.
Measurements Corp.
Meters, Inc.
Triplett Elec. Inst.

**VOLTMETERS, Thermo**

Am. Elec. Sales Co.
Assembly Products
Cambridge Inst. Co.
Cole Instrument
Dale Instruments
De Jur-Amsco Corp.
Electronic Development
General Elec. Co.

(Continued)

Lewis Engineering
Meters, Inc.
Rawson Electrical Inst.
Sensitive Research Inst.
Sun Manufacturing
Triplett Electrical Inst.
Welch Scientific
Westinghouse Elec.
Weston Elec. Inst. Corp.
Wheelco Inst. Co.

**VOLTMETERS, Vacuum Tube**

Aerovox Corp.
Ballantine Labs.
Barber Labs., Alfred
Beckman Instruments
Bradshaw Instruments
Cambridge Inst. Co.
Clippard Inst. Lab.
Clough-Brengle Co.
Cole Instrument
Dayton Acme Co.
Electronic Dev. Lab.
Electronic Instrument
Electronic Mfg. Co.
Electro Products Lab.
Feiler Engineering
Freed Transformer
General Elec. Co.
General Radio Co.
Hewlett-Packard
Hickok Elec. Instrument
Industrial Control Co.
Instrument Electronics
Jackson Elec. Co.
Measurements Corp.
Millen Mfg. Co.
Miller, M. C.
Millivac Instruments
Minnesota Electronics
Precision Apparatus Co.
Radio City Products Co.
RCA Div.
Reiner Electronics
Shallcross Mfg. Co.
Sherron Metallic
Southwestern Ind. Elec.
Sylvania Elec. Prod.
Televiso Co.
Triplett Electrical Inst.
Triumph Mfg. Co.
Victoreen Instrument
Welch Scientific
Weston Elect. Inst. Corp.

**VOLT-OHMMETERS**

Associated Research
Beckman Instruments
Beede Elec. Instrument
Bradshaw Instruments
Burlington Inst. Co.
Chicago Indust. Inst.
Clippard Inst. Lab.
Clough-Brengle Co.
Cole Instrument

(Continued)

Dale Instruments
DeJur-Amsco Corp.
Douglas Radio Labs.
Electronic Dev. Lab.
Electronic Instrument
Feiler Engineering
General Elec. Inst. Co.
Hickok Elec. Inst. Co.
Instruments Labs.
Jackson Electrical Inst.
Meters, Inc.
Precision Apparatus Corp.
Radio City Prod.
Rawson Electrical Inst.
RCA Div.
Reiner Electronics
Roller-Smith
Sensitive Research Co.
Shallcross Mfg. Co.
Sherron Metallic
Simpson Elec. Co.
Sticht Co.
Superior Instruments
Taco West Corp.
Triplett Electrical Inst.
Triumph Mfg. Co.
Universal Inst. Co.
Welch Scientific
Westinghouse Elec. & Mfg.
Weston Elec. Inst. Corp.

**VOLT-OHM-MILLIAMMETERS**

Bradshaw Instruments
Dale Instruments
Electronic Development
Electronic Instrument
Feiler Engineering
International Instruments
Instruments Labs.
Jackson Elec. Inst.
Marion Electrical Inst.
Meters, Inc.
Millivac Instruments
Precision Apparatus Co.
RCA Div.
Roller-Smith Co.
Simpson Electric Co.
Triplett Elec. Instrument
Welch Scientific
Westinghouse Elec.
Weston Elec. Inst. Corp.

**VOLUME CONTROLS**

Arca Regulators
Askania Regulator Co.
Carter Radio Co.
Centralab Div.
Clarostat Mfg. Co.
Daven Co.
General Radio Co.
Internat'l Resistance
Mallory & Co.
Poole Mfg.

(Continued)

Shallcross Controls
Shallcross Mfg. Co.
Southwestern Ind. Elec.
Triumph Mfg. Co.
U. S. Gauge
Utah Radio Prods.

**VOLUME INDICATORS Sound**
Amplifier Co.
Cole Instrument
Dale Instruments
Daven Co.
Electronic Development
Feller Engineering
General Radio Co.
Meters, Inc.

**WATCHES, Chronometer**
Bliss & Co.
Clebar Watch Co.
Ducommun Co.
Elgin National Watch
Hamilton Watch
Jaeger Watch Co.
Jardur Import Co.
Negus, T. S. & J. D.
Pastor Stop Watch
Sticht Co.
Technical Instruments
Waltham Watch

**WATCHES, Comparing**
Clebar Watch Co.
Ducommun Co.
Elgin National Watch
Hamilton Watch Co.
Jardur Import Co.
Negus, T. S. & J. D.
Waltham Watch Co.

**WATCHES, Navigation**
Clebar Watch Co.
Ducommun Co.
Elgin National Watch
Hamilton Watch Co.
Jardur Import Co.
Meridian Instrument
Negus, T. S. & J. D.
Waltham Watch Co.

**WATCHES, Stop**
Aristo Import Co.
Biddle Co., James G.
Central Scientific Co.
Clebar Watch Co.
Ducommun Co.
Elec. Facilities, Inc.
Elgin National Watch
Fish-Schurman Co.
Fisher Scientific Co.
Gaertner Scientific Corp.
Gallien, R. P.
Hamilton Watch
Jaeger Watch Co.
Jardur Import Co.
Negus, T. S. & J. D.
Pastor Stop Watch Co.
Pierce Scientific Co.
Precision Scientific Co.
Racine & Co., Jules
Scherr Co., Inc.
Speidel & Co.
Standard Elec. Time
Sticht Co.
Stoelting Co., C. H.
Tagliabue Div.
Testrite Instrument Co.
Waltham Watch
Warren Telechron
White Co.
Zernickow Co., O.

**WATCHES, Stop-Electric**
Central Scientific Co.
Clebar Watch Co.
Elgin Natl. Watch Co.
Jaeger Watch Co.
Jardur Import
Precision Scientific Co.
Standard Elec. Time
Sticht Co.
Stoelting Co., C. H.
Tagliabue Div.
Thompson Clock Co.
Waltham Watch

**WATER ANALYSIS OUTFITS**
Beckman Instruments
Gerin Corp.
Hagan Corp.
Hellige, Inc.
Howe & French, Inc.
La Motte Chemical Prods.
Taylor & Co., W. A.

**WATER BATHS, Constant Temperature (see Viscosimeter Baths)**

**WATER FEEDERS Automatic**
Askania Regulator Co.
Bailey Meter Co.
Climax Div.
Fischer & Porter
Henszey Co.
Kieley & Mueller
Magnetrol, Inc.
Mason-Neilan Regulator
McAlear Mfg.
Merritt Eng. & Sales Co.
Northern Equip. Co.
Penberthy Injector Co.
Photoswitch, Inc.
Watts Regulator Co.

**WATER METERS (See Liquid Meters)**

**WATER METER TESTERS (See testers, Water Meter)**

**WATER & SEDIMENT APPARATUS**
Barnstead Still
Central Scientific Co.
Davis Reg. Co.
Henry Valve
Instruments Corp.
McAlear Mfg. Co.
Precision Scientific Co.
Tagliabue Div.
Thomas Co., Arthur H.

**WATTHOUR METERS (See Meters, Watt-Hour)**

**WATTHOUR METER TESTERS (See Testers Watthour Meter)**

**WATTMETERS, Electrostatic**
General Electric Co.
Hickok Elec. Instrument
Sensitive Research Inst.

**WATTMETERS, Indicating**
Autocall Co.
Cole Instrument
General Elec. Co.
Hickok Elec. Inst. Co.
Landis & Gyr
Niagara Elec. Inst.
Norton Electrical Inst.
Rawson Electrical Inst.
Reliance Instrument Co.
Roller-Smith Co.
Sensitive Research Inst.
Sticht Co.
Welch Scientific
Triplett Elec. Inst.
Westinghouse Elec.
Weston Elec. Inst. Corp.

**WATTMETERS, Laboratory Standard**
Bird Electronic
Electrical Facilities Inc.
General Electric Co.
Rawson Elec. Inst.
Roller-Smith Inst.
Triplett Elec. Instrument
Welch Scientific

**WATTMETERS, Microwave**
Bird Electronic
Hewlett-Packard Co.
Rollin Co.
Sperry Gyroscope Co.

**WATTMETERS, Recording**
Bristol Co.
Cole Instrument
Esterline Angus Co.
General Elec. Co.
Hathaway Instrument
Hickok Elec. Inst.
Roller-Smith
Sensitive Research Inst.
Sticht Co.
Westinghouse Elec.

**WATTMETERS, Reactive**
Esterline-Angus
General Electric Co.
Roller Smith
Westinghouse Elec.

**WAVE METERS**
Antenna Research Lab.
Clarke Inst. Corp.
Electronic Dev. Lab.
Federal Telephone
General Electric
General Radio Co.
Jones Electronics
Kay Electric
Millen Mfg. Co.
RCA Manufacturing
Sperry Gyroscope Co.
Vectron, Inc.

**WAX MELTING APPARATUS**
Central Scientific Co.
Fisher Scientific Co.
Koehler Instrument
Precision Scientific Co.
Tagliabue Div.

**WEIGHT INDICATORS, Automatic Recording**
Exact Weight Scale Co.
Foxboro Co.
Howe Scale Co.
Merrick Scale Mfg.
Roller-Smith Co.
Streeter-Amet Co.
Toledo Scale Co.
Wiancko Engineering

**WEIGHING MACHINES (See various headings under "Scales—")**

**WEIGHTS, Analytical**
Ainsworth & Sons
Aloe Co., A. S.
Becker Div., Christian
Central Scientific Co.
Dietert Co.
Exact Weight Scale Co.
Fisher Scientific Co.
Gurley, W. & L. E.
Howe Scale Co.
**Ohaus Scale Corp.**
Roller Smith
Seedburo Equipment
Seederer-Kolbusch, Inc.
Thomas Co., Arthur H.
Thompson Balance
Troemmer, Henry
Voland & Sons, Inc.
Welch Scientific

**WEIGHTS, Avoirdupois**
Becker Div., Christian
Central Scientific Co.
Exact Weight Scale Co.
Gurley, W. & L. E.
Howe Scale Co.
Ohaus Scale Corp.
Seederer-Kohlbusch, Inc.
Toledo Scale Co.
Troemmer, Henry
Voland & Sons, Inc.

**WEIGHTS, Metric**
Ainsworth & Sons
Becker Div., Christian
Central Scientific Co.
Chicago Apparatus Co.
Exact Weight Scale Co.
Gaertner Scientific Corp.
Gurley, W. & L. E.
Humboldt Mfg. Co.
Ohaus Scale Corp.
Seederer-Kohlbusch, Inc.
Suter, Alfred
Thompson Balance
Toledo Scale Co.
Troemmer, Henry
Voland & Sons, Inc.
Welch Scientific Co.

**WEIGHTS, Test (See Weights, Avoirdupois, Metric or Troy)**

**WEIGHTS, Troy**
Becker Div., Christian
Central Scientific Co.
Exact Scale Co.
Gurley, W. & L. E.
Howe Scale Co.
Ohaus Scale Corp.
Seederer-Kohlbusch, Inc.
Toledo Scale Co.
Thompson Balance
Troemmer, Henry
Voland & Sons

**WEIGHTS & MEASURES PRECISION STANDARD**
Gurley, W. & L. E.
Jacobs Bros. Co.
Pfaltz & Bauer, Inc.
Seederer-Kohlbusch, Inc.
Thompson Balance
Torsion Balance Co.
Troemmer, Henry
Voland & Sons

**WEIR METERS (See Flowmeters, Weir)**

**WELLS, Thermocouple see Tubes, Pyrometer**

**WIND DIRECTION & VELOCITY INDICATORS**
Alfax Paper & Eng.
Doelcam Corp.
Electric Speed Ind. Co.
Elec. Tachometer Corp.
Friez Instrument
General Elec. Co.
Geophysical Inst. Co.
Green, Henry J.
Hastings Inst. Co.
Hays Corp.
Illinois Testing Labs.
Kenyon Instrument Co.
Stewart, M. C.
Taylor Instrument Cos.
Westberg Mfg. Co.
Westinghouse Elec.

**WIND DIRECTION & VELOCITY RECORDERS**
Doelcam Corp.
Elec. Tachometer Corp.
Friez Instrument
General Electric Co.
Geophysical Instrument
Green, Henry J.
Hastings Inst. Co.
Hays Corp.
Hickok Elec. Instrument
Illinois Testing Labs.
Instruments Corp.
Kenyon Instrument Co.
Leeds & Northrup Co.
Stewart, M. C.
Wallace & Tiernan
Westinghouse Elec.
Zeiss, Inc., Carl.

**WIND GAGES (See Gages, Wind)**

**WIND TUNNEL INSTRUMENTS**
Askania Regulator
Automatic Temp. Control
Gaertner Scientific
Huggins Labs.
Illinois Testing Labs.
Industrial Electronics
Potter Instrument
Stratex Instrument
Tinsley Labs.
Toledo Scale
Wiancko Engineering

**WIRES, Gear Measuring**
Acme Industrial
Van Keuren Co.
Size Control Co.

**WIRES, Thermocouple (See Under Thermocouples)**

**WIRES, Thread Measuring**
Brown & Sharpe
Elgin National Watch
Ferner Co.
Scherr Co., Inc.
Sheffield Gage
Size Control Co.
Van Keuren Co.

**WOW METER**
Brush Development
Furst Electronics
Kay Electric Co.

**X-RAY CAMERAS, Difraction**
American Inst. Co.
Baird Associates
Distillation Products, Inc.
Farrand Optical Co.
General Elec. X-Ray Dept.
Hayes Scientific App.
Jarrel-Ash Co.
**North Amer. Phillips**
Picker X-Ray
RCA Div.
Summers Gyroscope
Wyland, G. C.

**X-RAY EQUIPMENT**
Allis-Chalmers
Aloe Co., A. S.
Baird Associates
Bar-Ray Products
Campbell Electric
Fish-Schurman Co.
General Elec. X-Ray Dept.
Hayes Scientific App.
High Voltage Eng.
Industrial X-Ray Labs.
Jarrell-Ash Co.
Kelley-Koett Mfg. Co.
North Amer. Philips
Patterson Screen Co.
Picker X-Ray
Shallcross Mfg. Co.
Stoelting Co., C. H.
Universal X-Ray Prods.
Westinghouse Elec.
Westinghouse X-Ray Co.
Wyland, G. C.

**X-RAY FLUOROSCOPIC SCREENS (See Screens, X-Ray Fluoroscopic)**

**X-RAY INTENSIFYING SCREENS (See Screens, X-Ray Intensifying)**

**X-RAY MEASURING INSTRUMENTS**
Canadian Radium
Cyclotron Specialties
Herbach & Rademan
High Voltage Engg.
Instrument Dev. Labs.
Martin-Hubbard Corp.
Radiation Counter Labs.
Technical Associates
Victoreen Inst. Co.

**X-RAY SPECTROGRAPHS (See Spectographs, (X-Ray)**

**X-RAY SPECTROMETERS**
**X-RAY STEREOSCOPE (See Stereoscope, X-Ray)**

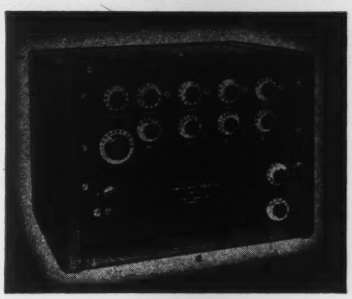
**X-RAY TUBES (See Tubes, X-Ray**

**X-RAY VOLTMETER, High Potential**
Bradshaw Instruments
Cole Instrument
General Elec. X-Ray Dept.
Hickok Elect. Inst. Co.
Kelley-Koett Mfg. Co.
Meters, Inc.
Precise Measurements Co.
Rawson Elec. Inst. Co.
Shallcross Mfg. Co.
Westinghouse Elec.

**Z-ANGLE METER, Audio Frequency**
Kay Electric Co.
Marconi Insts. Ltd.
Technology Inst. Corp.

**Z-ANGLE METER, Radio Frequency**
Marconi Insts., Ltd.
Technology Inst. Corp.

**COMPLEX WAVE GENERATOR**



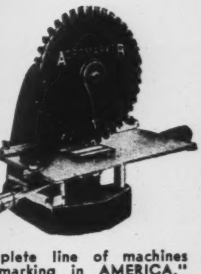
**SPECIFICATIONS:**
FUNDAMENTAL: 50 - 3000 cycles
HARMONICS: 2nd, 3rd, 4th and 5th
PHASE: Each Harmonic 0 to ± 180°
AMPLITUDES: Each Harmonic 0 to 100%
OUTPUT: 1 volt of Fund. or Harmonic

**APPLICATIONS:**
Wave Form Study, Distortion Measurement, Phase Study, Syncro Mechanism Response, Fourier Wave Synthesis, Teaching, Study and Measurement.

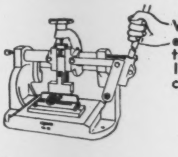
**ALFRED W. BARBER LABORATORIES**
32-44 Francis Lewis Boulevard, Flushing, N. Y.

**MACHINES for MARKING & NUMBERING**

HAND
MOTOR
DRIVEN
AIR



"The most complete line of machines and tools for marking in AMERICA." Equipment for marking and stamping, embossing, printing and stenciling methods. Steel type, stamps, numbering and marking machines carried in stock.

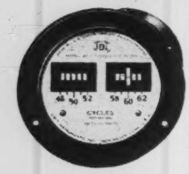


Write for new general catalog illustrating more than 150 tools and machines for marking.

The ACROMARK Company
3-11 Morrell St.
ELIZABETH 4, N.J.

# VIBRATING REED FREQUENCY METERS

**Panel Mounting or Portable, for use when constant or known frequency is important to efficient operation of equipment.**



- **Permanently Accurate** within ±0.3% or better, depending on the model. This accuracy is not affected by poor wave form, external magnetic disturbances, or voltage fluctuations.
- **Size and Type for Every Service.** Made in a wide variety of portable and panel case styles, reed groupings and frequency ranges from 12 to 525 cycles and above; 100-130 volts is standard.
- **Rugged Construction** of simplified, patented design, with no moving parts to wear out or get out of calibration. Ideal for field and mobile applications.

*Ask for Bulletins VF-43, VF-43-1A-1B-1C-1D, and General Catalog 451*

## NEW DEVELOPMENT

**400 Cycle Dual Range — 2, 5 and 10 Cycle Steps**

**Model 41-FX** — Designed originally for high-quality electrical analyzers of heavy aircraft, this 4" meter is finding many additional applications. The top window with 13 reeds gives a vernier effect indicating 380-420 cycles, with 2 cycle increments in the critical range of 396-404 cycles. The bottom window frames 21 reeds 300-500 cycles in 10 cycle steps for a general idea of the frequency under test. When used with external switching, three voltages: 200-240; 115; and 30 volts can be supplied.

Where 400 cycle readings are important, the Model 41-FX is the all-round working standard — precise for the laboratory, rugged for shop and field.

## ELAPSED TIME METERS

**For Maintenance, Tube Life Data, and Operating Time Records—on Motor Generators, Transmitters, Receivers, Rectifiers, Test Set-ups, etc.**

JBT
ELAPSED TIME METER
HOURS

**Model 31-EX** (illustrated) also known as running-time or total time meter, registers in 1/10 hours to 9,999.9 hours, then automatically resets. Normally stocked for 60 cycles, 110-130 volts. 3½" standard meter mounting. Variations such as 50 cycles; 230 volts; 0-99,999 hours; and 3" rectangular case available on special order.

## SEALED TIME METERS

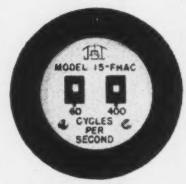
**Model 31-EHXX**—Completely sealed meter, reading 0-9,999.9 hours, same as Model 31-EX above. Glass-to-metal construction, solder terminals, and 3½" detachable flange, all match XX metal frequency meter case. For mounting, use Sketch SK-53. While not presently stocked, these meters are in production.

**3½" SEALED Frequency Meters**

JBT
58
60
62
CYCLES
PER SECOND

**FHXX Type Meters,** sealed, glass-to-metal construction, with solder terminals, meets or exceeds the sealing and electrical requirements of JAN-I-6 and MIL-M-6A including the 3000 volt breakdown, and uses the front mounting dimensions specified. Max. barrel diameter, 2 11/16"; 2⅞" overall depth behind flange. Various reed groupings and frequency ranges from 12 to 525 cycles and above; 100-130 volts standard. While not regularly stocked, these meters are in production. See print SK-51, and Catalog 451.

**1½" SEALED Frequency Meters**



**Model 15-FHAC** (illustrated half actual size). 60 and 400 cycles, 2 reeds, 8-10 volts, for cathode follower circuit. Widely used on audio oscillators to standardize output. Meets intent JAN-I-6 and amendments on sealed meters. Barrel, 1½" diameter; detachable flange, 2.094" diameter; solder terminals.

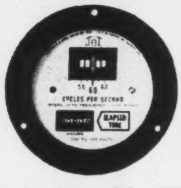
**Model 15-FH** (not illustrated)--same case, sealed, 5 reeds, 58-62 cycles, 100-130 volts. Variations such as 6 reeds, 25 or 400 cycle ranges and higher voltages available on special order.

### NOTE ON METER VOLTAGE

J-B-T Vibrating Reed Frequency Meters of all sizes normally are made with two studs and are designed to be connected across one phase of a multi-phase line. The single phase voltage where the meter will be used thus becomes the voltage to be specified for the meter. Special meters with extra studs are made only for the purpose of reading two or more voltages, not additional phases.

## FREQUENCY-TIME METERS

**Combination Reed-Type Frequency-Elapsed Time Meters — One Meter Does The Work of Two**

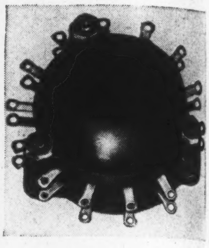


**Model 31-FE** (illustrated) pioneered by J-B-T, saves panel space and cost. Useful on electrical and electronic equipment, also power units, where both frequency and periodic maintenance are important. 3¼" flange, metal case, 4 11/32" overall depth standard. 3½" case, known as 31-FEX-1 supplied on custom orders. 5 reeds, 60 cycle range, standard; 7, 9, 11 reeds or 50 cycle range on special order. For other details, see Elapsed Time Meters in column to the left.

# ROTARY SELECTOR SWITCHES

## INSTRUMENT TYPE MOLDED SWITCHES

**Fully Enclosed**
**Single and**
**Multi-Gang**
**Shorting and**
**Non-Shorting***
**14 and 20**
**Positions**
**1 to 6 Decks**



*Model MS-14-2*

- All moving contacts enclosed — eliminates dirt and corrosion.
- Contact lugs permanently integrated into switch assembly.
- Sturdy construction with 3-post deck suspension, double-grip collector arms, and rectangular drive shaft through decks for precision indexing.
- Interchangeable, electrically and mechanically with J-B-T Series SS-14 and 20 position Laminated Switches, widely used by industry and the Armed Services.

Normal carrying capacity (not make-and-break) 1 amp.; maximum momentary capacity (not make-and-break) 5 amp.; maximum voltage between contacts and ground, 1000 volts R.M.S.; between decks and ground, 2000 volts R.M.S. Average contact resistance 0.007 ohms or less.

**Ask for Catalog 451*

## INSTRUMENT TYPE LAMINATED SWITCHES

*Model SS-14-2*

Used widely in quality test equipment, portable instruments, inspection setups and avionics where trouble-free, dependable performance is of major importance. Available in two basic types — 14 and 20 position — the design gives extra contacts in minimum space. One to six decks.

## LEVER ACTION SWITCHES

*Model SS-14-16H*

Excellent for test equipment and communications systems, these switches use the same high quality parts as the SS-14 series. Bracket mounting holes 1⅝" apart; may be mounted in groups ⅝" between centers. Individually boxed with knobs. Positive indexing type. Available with 3 pos. or 4 pos., Shorting or Non-Shorting.

## OTHER J-B-T PRODUCTS

APPLIANCE TEMPERATURE TESTERS
TEMPERATURE INDICATORS
LABORATORY GALVANOMETERS
VACUUM TUBE FREQUENCY METERS

## DISTRIBUTOR SERVICE

Standard J-B-T items are available through authorized electronics parts distributors.

# J-B-T INSTRUMENTS, INC.

443 CHAPEL STREET
NEW HAVEN 8, CONN.

# DESCRIPTIVE DIRECTORY

## Of Manufacturers and Sole Representatives Selling Instruments and Devices Used for Measurement, Inspection, Testing and Automatic Control

**Advertisers are indicated by bold-face type**

These Manufacturers Produce Instruments and Devices for measurement, inspection, testing and control for increased productivity.

## A

Abrams Instrument Co., 606 E. Shiawasse St., Lansing, Mich.
Aerial Cameras, Stereoscopes, Triangulators, Mapping Projectors, Aerial Surveying Instruments

Accuracy Scientific Instruments Co., 2903 N. 12th St., Philadelphia 33, Pa.
Thermometers, hydrometers, thermo-hydrometers, thermo-regulators

Accurate Pyrometric Cone Co., Pataskala, Ohio
Seger cones

Accurate Instrument Co., Inc., 3456 N. Clark St., Chicago 13, Ill
Thermometers

Ace Glass Inc., Vineland, N. J.
Chemical & laboratory glassware

Ace Instrument Co., Inc., 172 Pacific St., Brooklyn 2, N.Y.
Combustion control instruments

Acme Industrial Co., 1512 W. Lake St., Chicago, Ill.
Machine shop gages

Acme Regulator Co., Box 268, Tulsa 1, Okla.
High Pressure regulators

Acme Scientific Co., 1450 West Randolph St., Chicago 7, Ill.
Optical flats and light sources

**Acragage Co., Wampus Lane, Milford, Conn.**
Pressure, vacuum and liquid level instruments
**(See advertisement on page 73)**

**Acromark Co., 3-11 Morrell St., Elizabeth 4, N. J.**
Engraving, numbering and marking machines
**(See advertisement on page 155)**

Acro Switch Div., Acro Mfg. Co., 2030 E. Main St., Columbus 9, Ohio
Snap action switches

Adams & Westlake, Elkhart, Ind.
Relays

Adde & Co., 57 Kennebec St., Portland 2, Maine
Counters

Adel Precision Products Corp., 10777 Van Owen St., Burbank, Calif.
Hydraulic actuators and remote control equipment

**Advance Electric & Relay Co., 2435 N. Naomi St., Burbank, Calif.**
Relays
**(See advertisement on page 115)**

Aero Electronics Co., 1902 W. Division St., Chicago 22, Ill.
Aircraft and industrial instruments

Aero Instrument Co., 11423 Vanowen St., No. Hollywood, Calif.
Airbourne and ground-station instruments

Aero Instrument Co., 5105 Denison Ave., Cleveland 2, Ohio
Airspeed tubes

Aerolite Electronic Hardware Corp., 507 26th St., Union City, N. J.
Radio hardware, connectors

**Aeromarine Instrument Co., Inc., 385 Gerard Ave., New York 51, N. Y.**
Aircraft, marine and industrial instruments
**(See advertisement on page 76)**

Aeroquip Corp., 300 South East St., Jackson, Mich.
Dynamic pressure gages

Aerovox Corporation, New Bedford, Mass.
Capacitors & resistors

Agfa Ansco, Binghamton, N. Y.
Electronic photometer

Ahrendt Instrument Co., 4910 Calvert Rd., College Park, Md.
Power supplies; servomechanism testers

Ainsworth & Sons, Inc. Wm., 2151 Lawrence St. Denver 2, Colo.
Analytical, micro, assay & pulp balances & weights, pocket transits

Air Instrument Corp., 1562 Main St., Springfield, Mass.
Height Gages

Airbourne Instruments Laboratory, Inc., 160 Old Country Rd., Mineola, L. I., N. Y.
Polar and rectangular coordinate recorders, electronic instruments

Aircraft Electronics Associates, Inc., 94 Silas Deane Highway, Rocky Hill, Conn.
Aircraft instruments and testers

Aircraft-Marine Products, Inc., 1521-39 No. 4th St., Harrisburg, Pa.
Repair kits, connectors

Aircraft Radio Corp., Boonton, N. J.
Electronic instruments

Airdesign Incorporated, 241 Fairchild Ave., Upper Darby, Pa.
Audio-frequency equipment, transformers

Airdraulics Engineering, Inc., Overhill Ave., Rye, N. Y.
Torque Testers

AiResearch Mfg. Co., 9851 Spulveda Blvd., Los Angeles 45, Calif.
Airbourne and ground-station instruments, computers, actuators

Airflo Instrument Co., 122 Naubuc Ave., Glastonbury, Conn.
Special probes for measuring gas velocity, direction, temperature and pressure

Airite Products Co., Inc., 3528 Union Pacific Ave., Los Angeles 23, Calif.
Fire detectors

Airplane & Marine Instruments, Inc., Clearfield, Pa.
Absolute pressure gage

Alden Products Co., Inc., 117 N. Main St., Brockton 64, Mass.
Oscillographs, radiosondes, fascimile recorders

Alfab Manfacturing Co., 8320 Millet St., Houston 12, Texas
Laboratory furniture

Alfax' Paper & Engr. Co., Washington St., Westboro, Mass.
Accelerometers, barometers & clinometers

Alina Corp., 32 Broadway, New York 4, N. Y.
Clocks, differential pressure gages, time meters and switches, toolmakers' microscopes

**All American Tool & Mfg. Co., 1014 W. Fullerton Ave., Chicago 14, Ill.**
Vibration fatigue testers
**(See advertisement on page 131)**

Allen-Bradley Co., 136 W. Greenfield St., Milwaukee 4, Wis.
Electric control apparatus

Allied Control Co., Inc., 2 East End Ave., New York 21, N. Y.
Relays, switches & remote control equipment

Allied Engraving & Stamping Co., 161 Elliott St., Buffalo 3, N. Y.
Instrument panels

Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
Amplifiers and audio-frequency equipment

Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.
Position indicators, frequency load & phase regulators

Alpha Instrument Co., 2103 K St., N. W., Washington 7, D. C.
Meteorological instruments

Alpha-Lux Co., Inc., 155 John St., New York, N. Y.
Moisture testers

Altender & Sons, Theo., 1219 Spring Garden St., Philadelphia 23, Pa.
Drawing instruments

Aluminum Co. of America, 801 Gulf Bldg., Pittsburgh 19, Pa.
Aluminum instrument tubing

American Blower Corp., 6000 Russell St., Detroit 32, Mich.
Manometers

**American Chain & Cable Co., Helcoid Gage Div., 929 Connecticut Ave., Bridgeport 2, Conn.**
Bourdon tube gages & pressure indicators
**(See advertisement on page 75)**

American Chronoscope Corp., 316 W. First St., Mt. Vernon, N. Y.
Time study instruments, steam meters

American Communications Corp., 308 Broadway, New York 7, N. Y.
Audio-frequency equipment, battery chargers, instrument panels

American Condenser Co., 4410 Ravenwood Ave., Chicago, Ill.
Capacitors

American Cystoscope Makers, Inc., 1241 Lafayette Ave., New York 59, N. Y.
Bore inspection devices and internal surface inspection devices

American Electroneering Corp., 5025 W. Jefferson Blvd., Los Angeles 16, Calif.
Electronic instruments

American Gage Co., 143 17th Ave., Paterson 3, N. J.
Profile, ring and snap gages

American Gas Accumulator Co., 1029 Newark Ave., Elizabeth, N. J.
Time delay relays

American Indicator-Paper Co., 4611 N. Kostner Ave., Chicago 30, Ill.
Chemical indicator papers

American Instrument Co., 8010-8020 Georgia Ave., Silver Spring, Md.
Scientific instruments & materials testing apparatus

American Lens Co., 45 Lispenard St., New York, N. Y.
Cathode-ray tubes and lenses

American Measuring Instruments Corp., 240 W. 40th St., New York 18, N. Y.
Precision measuring instruments

**American Meter Co., 1513 Race St., Philadelphia 2, Pa.**
Tinned case & ironcase positive displacement gas & air meters, pressure reducing regulators, meter testing apparatus, indicating, recording & integrating flowmeters, rate volume & liquid level controllers & remote controllers
**(See advertisement on page 19)**

American Optical Co., Instrument Div., Box A, Buffalo 15, N. Y.
Scientific optical instruments, projection apparatus, testing equipment and optical parts, microscopes, microtomes, refractometers, spectrometers, visual colorimeters, illuminators, delineascopes, magnifiers, and special lenses, prisms and mirrors for industrial and educational purposes.

**American Paulin System, 1874 So. Flower St., Los Angeles 15, Calif.**
Meteorological instruments, altimeters, barometers
**(See advertisement on page 48)**

American Relay & Controls, Inc., 4901 W. Flournoy St., Chicago 44, Ill.
Relays, switches, coils, etc.

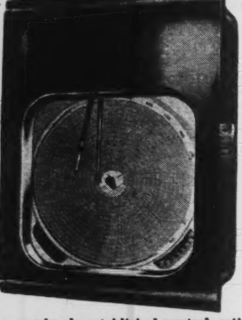
American Temperature Indicating Co., 1017 Summit St., Toledo 4. Ohio
Electrical resistance thermometers

**American Thermo-Electric Co., 67 East 8th St., New York 3, N. Y.**
Vacuum, separate heater & contact type thermocouples
**(See advertisement on page 134)**

**American Time Products, Inc., 580 Fifth Ave., New York 19, N. Y.**
Timing Systems, frequency standards
**(See advertisement on page 36)**

American Transformer Co., 178 Emmet St., Newark, N. J.
Transformers & electrical apparatus including voltage regulators, high voltage testing sets, rectifiers

BRISTOL'S
SERIES 500
AIR-OPERATED
Automatic Controllers



**Reproduces previously-established control actions . . . duplicates control actions in any other Series 500 Controller . . . easily, accurately. So you can standardize controller adjustments . . . save cut-and-try methods of duplicating settings.**
**Simplest control system to service. Only one service adjustment needed.** Almost anybody can service a Series 500 Controller.
**Five types of control:** on-and-off, proportional, proportional plus derivative, reset, reset plus derivative. **Available for temperature, pressure, liquid level, flow, humidity and pH.**

Write for Bulletins A120, A115 and C305.

THE BRISTOL COMPANY
113 BRISTOL RD., WATERBURY 20, CONN.

Amerline, 1753 N. Honore St., Chicago 22, Ill.
Radio tube testers; spark plug testers

Ames Co., B. C., 131 Lexington St., Waltham, Mass.
Comparator & dial gages, length measuring devices

Ames Precision Machine Works, 131 Lexington St., Waltham, Mass.
Instrument lathes; hardness testers

**Amglo Corp., 4234 Lincoln Ave., Chicago, Ill.**
Gas discharge tubes; constant-speed d-c. timer motors
**(See advertisement on page 38)**

Amperite Corp., 561 Broadway, New York 12, N. Y.
Microphones

Ampex Electric Corp., 934 Charter St., Redwood City, Calif.
Magnetic tape recorder

Amplifier Corp. of America, 398 Broadway, New York 13, N. Y.
Amplifiers

**Amthor Testing Instrument Co., Inc., 48 Van Sinderen Ave., Brooklyn 7, N. Y.**
Physical testing machines
**(See advertisement on page 132)**

Analysis Sales Co., 1827 Union Commerce Bldg., Cleveland 14, Ohio
Impact recorders

Anders Company, 5450 Wissahicken Ave., Philadel-
Instrument airdryers
phia, Pa.

Anderson, Arthur R., 110 Woodbury Ave., Springdale (Stamford), Conn.
Strain gages

Anderson Bros. Mfg. Co., 1910 Kishwaukee St., Rockford, Ill.
Balancing machines

Anetsberger Bros., Inc., Northbrook, Ind.
Temperature and humidity test chambers

Angle Computor Co., Inc., 1709 Standard Ave., Glendale 1, Calif.
Universal angle computers

Annin Company, 3500 Union Pacific Ave., Los Angeles 23, Calif.
Control valves

Annis Company, R. B., 1101 N. Delaware St., Indianapolis, Ind.
Permeameters, balancing machines

Antenna Research Lab., Inc., 797 Thomas Lane, Columbus 14, Ohio
Electronic instruments, amplifiers, computers

Applied Physics Corp., 362 W. Colorado St., Pasadena 1, Los Angeles, Calif.
Cary recording quartz spectrophotometer, Vibrating reed electrometer, color analyzers.

**Applied Research Labs., 3717 Park Place, Montrose, Calif.**
Spectromechanical testing apparatus including spectrographs projection comparators, densitometers & power source units for arc & spark analysis.
**(See advertisement on page 123)**

Applied Science Corp. of Princeton, P.O. Box 44, Princeton, N. J.
Research and development in electronics and physics

Arca Regulators, Inc., Upper Montclair, N. J.
Hydraulic & air operated controls

Aristo Import Co., Inc., 630 Fifth Ave., New York 20, N. Y.
Stop watches

Arma Corporation, 254 36th St., Brooklyn, N. Y.
Automatic inspection equipment

Arnold Engineering Co., P.O. Box G, Marengo, Ill.
Permanent magnets

Arrow-Hart & Hegeman Electric Co., 103 Hawthorne St., Hartford 7, Conn.
Magnetic, mercury & relay switches

Ashton Valve Company, 161 First St., Cambridge, Mass.
Pop safety & relief valves, pressure gage, gage testers & master pilot & master pressure gages

**Askania Regulator Co., 240 E. Ontario St., Chicago 11, Ill.**
Automatic control instruments
**(See advertisement on page 115)**

Assembly Products, Inc., Main & Bell Sts., Chagrin Falls, Ohio
Electrical indicating instruments and accessories

**Associated Research, Inc., 3758 W. Belmont Ave., Chicago 18, Ill.**
Vibrotest insulation testing equipment. Special measuring & testing instruments of electrical nature.
**(See advertisement on page 127)**

Associated Valve & Engr. Co., 1150 W. Marquette Road, Chicago 21, Ill.
Automatic controllers; control valves; components

**Atkomatic Valve Co., Inc., 545 Abbott St., Indianapolis, Ind.**
**(See advertisement on page 148)**

Atlas Electric Devices Co., 361 West Superior St., Chicago 10, Ill.
Fade-Ometer, Weather-Ometer, Launder-Ometer

Atlas Exploration Co., 1911 West Alabama St., Houston 6, Texas
Geophysical instruments

Atlas Valve Co., 282 South St., Newark 5, N. J.
Regulator valves

**Atomic Instrument Co., 84 Massachusetts Ave., Cambridge, Mass.**
Radioactive detectors and electronic instruments
**(See advertisement on page 64)**

Audio Development Co., Transformer Div., 2833 13th Ave., Minneapolis 7, Minn.
Transformers, audio frequency equipment

Audio Instrument Co., 133 W. 14th St., New York 11, N. Y.
Audio-frequency equipment

Audio-Tone Oscillator Co., 237 John St., Bridgeport 3, Conn.
Radio Test Instruments

Auth Electrical Specialty Co., Inc., 422 E. 53 St., New York 22, N. Y.
Signaling devices

Autocall Co., Shelby, Ohio
Electrical signaling, control & metering devices

Autoclave Engineers, Inc., P. O. Box 1027, Erie, Pa.
High pressure autoclaves, valves and thermocouples

Automatic Control Co., 1005 University Ave., St. Paul 4, Minn.
Circuit switches for automatic level controls, automatic timing & sequence controllers

Automatic Electric Mfg. Co., Mankato, Minn.
Time switches & interval timers

**Automatic Electric Sales Co., 1033 W. Van Buren St., Chicago 7, Ill.**
Telephone signaling & communication apparatus
**(See advertisement on page 125)**

Automatic Scale Co., Inc., 591 Hudson St., New York 14, N. Y.
Automatic scales

Automatic Switch Co., 391 Lakeside Ave., Orange, N. J.
Solenoid operated valves & automatic electric control apparatus

Automatic Temperature Control Co., 5212 Pulaski Ave., Philadelphia 44, Pa.
Timers, time control and specialty engineering. Valves & valve controllers, various types of relays.

Automatic Valve Controller Co., Box 268, Tulsa 1, Okla.
Automatic valve control

Autotron Co., Danville, Ill.
Automatic inspection devices

# B

Bacharach Industrial Instrument Co., 7000 Bennett St., Pittsburgh 8, Pa.
Industrial instruments

Badger Meter Mfg. Co., 2371 North 30th St., Milwaukee 10, Wis.
Liquid meters

**Bailey Meter Co., 1050 Ivanhoe Rd., Cleveland 10, Ohio**
Metering & control equipment for power plants & industrial processes. Power plant instruments; boiler meter, meter combustion control operating directly from boiler meter, three-element feed water control, steam superheat control, desuperheating & pressure reducing control. Also metering & control equipment for sewage treatment, water supply & processing industries
**(See advertisements on pages 49, 55, 56, 60, 63, 76, 91, 109)**

**Baird Associates, 33 University Road, Cambridge 38, Mass.**
Specialized physical & optical instruments including complete line of spectrographic & x-ray diffraction equipment
**(See advertisement on page 122)**

Baker & Co., Inc., 113 Astor St., Newark 5, N. J.
Thermocouple wire; microchemical apparatus

Baker Compass Co., Melrose, Mass.
Compasses

**Baldwin-Lima-Hamilton Corp., Testing Machine Dept., Eddystone, Pa.**
Universal testing machines
**(See advertisement on page 2)**

**Ballantine Labs., Inc., Boonton, N. J.**
Artificial ears, electronic voltmeters, sound meters, vibration pickups, throat microphone, telephone receiver test equipment
**(See advertisement on page 153)**

Baltimore Biological Laboratory, 1640 Gorsuch Ave., Baltimore 18, Md.
Laboratory filling machines, pumps, etc.

Bar-Ray Products, Inc., 209 25th St., Brooklyn, N. Y.
X-ray equipment

Barber-Colman Co., Rockford, Ill.
Automatic controlling instruments for temperature, humidity, pressure, liquid level, moisture regain, motor-operated valves, solenoid valves, electric power units, damper controllers, voltage sensitive relays, associated switches & relays, fractional H. P. motors, geared motor units & hardness testers.

**Barber Laboratories, Alfred W., 34-04 Francis Lewis Blvd., Flushing, L. I., N. Y.**
Voltmeters
**(See advertisement on page 155)**

Barbour Stockwell Co., 205 Broadway, Cambridge, Mass.
Tachometers

**Barksdale Valves, 1566 E. Slanson Ave., Los Angeles, Calif.**
Control valves
**(See advertisement on page 125)**

Barnes Co., W. F. & John, 301 S. Water St., Rockford, Ill.
Automatic control equipment

Barnstead Still & Sterilizer Co. Inc., 2 Lanesville Terrace, Boston 31, Mass.
Water stills

Bartelt Engineering Co., 1214 Patridge Ave., Beloit, Wis.
Pedestal micrometers

Barr Instrument Co., Inc., 134-39 225 St., Springfield Gardens 13, N. Y.
Dimensional Gages

Barry Corp., 700 Pleasant St., Watertown 72, Mass.
Vibration mountings and isolators

**Barton Instrument Co., 1429 S. Eastern Ave., Los Angeles 22, Calif.**
Flowmeters & gages
**(See advertisement on page 71)**

Bastian-Blessing Co., 4201 W. Peterson St., Chicago 30, Ill.
Regulating valves

Bausch & Lomb Optical Co., 635 St. Paul St., Rochester, N. Y.
Optical instruments for industrial, scientific & educational use including microscopes, colorimeters, refractometers, photomicrographic & metallographic equipment, contour measuring projector, optical glass & special optical systems

Bayside Watch Tool Co., 211-12 Northern Blvd., Bayside, L. I., N. Y.
Machines, tools and dies for watch, clock and instrument industries

**Beacon Gage Co., 11 River St., Wellesley, Mass.**
Pressure gages
**(See advertisement on page 78)**

Beam Instruments Corp., 350 Fifth Ave., New York 1, N. Y.
Electronic instruments, cameras, testers

Bear Manufacturing Co., Rock Island, Ill.
Balancing machines

Beck Bros., 421 Sedgely Ave., Philadelphia 40, Pa.
Resistors

Beck Co., Harold, 3640 N. Second St., Philadelphia 40, Pa.
Pyrometer controllers

Becker Div., Christian; Torsion Balance Co., Clifton, N. J.
Precision balances & weights, including analytical, assay, magnetically damped, diamond, specific gravity, dairy druggists, textile.

**Beckman, Inc., Arnold O., 1020 Mission St., So. Pasadena, Calif.**
Scientific and industrial instruments; automatic gas analyzers and detectors; radioactivity detectors; dosemeters
**(See advertisement on page 81)**

Beckman Instruments, Inc., 830 Mission St., So. Pasadena, Calif.
pH instruments and electro-metric pH equipment for completely automatic indication, control and recording

Beckman & Whitley, San Carlos, Calif.
Anemometers, special cameras

Beede Electrical Instrument Co., Penacook, N. H.
Small electrical panel instruments

Bell & Howell Co., 7100 McCormick Rd., Chicago 45, Ill.
Motion picture equipment including cameras, projectors & accessories

Belco Glass, Inc., 413 N. 4 St., Vineland, N. J.

Berge, J. & H., 145 Hudson St., New York 13, N. Y.
Laboratory supplies

**Bendix Aviation Corp., Eclipse-Pioneer Div., Teterboro, N. J.**
**(See advertisement on pages 97, 113)**

**Bendix Aviation Corp., Pacific Div., 11600 Sherman Way, N. Hollywood, Calif.**
Airborne and ground instruments, industrial measuring, telemetering and remote control systems
**(See advertisement on page 118)**

Berger & Sons, Inc., C. L., 37 Williams St., Roxbury, Boston 19, Mass.
Surveying instruments

**Berkeley Scientific Corp., 2200 Wright Ave., Richmond, Calif.**
Radioactivity measurement instruments, & spectrometers
**(See advertisement on page 67)**

Berkshire Labs., 582 Lexington Rd., Concord, Mass.
Optical, electrical and electronic instruments

Beseler Co., Charles, 60 Badger Ave., Newark 8, N. J.
Optical projectors, galvanometer projectors, delineascopes

Best Scientific Glass App. Wks., 2449 N. Clybourn St., Chicago 14, Ill.

Bethlehem Apparatus Co., Front & Depot Sts., Hellertown, Pa.
Laboratory Apparatus, mercury cleaning machines

Betts & Betts Corp., 551 West 52nd St., New York 19, N. Y.
Multiple circuit timers, controls, time delay relays & motor driven & thermostatic interrupters

**Biddle Co., James G., 1316 Arch St., Philadelphia, Pa.**
Insulation testers, ground testers & ohmmeters, speed-measuring instruments, frequency meters, sliding-contact rheostats
**(See advertisement on page 129)**

Bidwell Instrument Co., 1007 Troy Place, N. W., Canton 3, Ohio
Microchemical laboratory apparatus; custom built research instruments.

Bin-Dictator Co., 14615 East Jefferson Ave., Detroit 15, Mich.
Automatic bin level indication & control

Binswanger & Co., 645-655 Union Ave., Memphis 1, Tenn.
Lenses, prisms & filters, Glass of every description

Bird Electronic Corp., 1800 E. 38th St., Cleveland 14, Ohio
Switches, wattmeters

**Bird & Co., Richard H., 1 Spruce St., Waltham 54, Mass.**
Jewel bearings
**(See advertisement on page 49)**

Black & Decker Mfg. Co., 715 Pennsylvania Ave., Towson, Md.
Truck scales

**Black, Sivalls & Bryson, Inc., 7500 E. 12 St., Kansas City 3, Mo.**
Automatic controllers, governors, valves
**(See advertisements on pages 9, 10, 11, 12)**

Black & Webster, Inc., 445 Watertown St., Newton 58, Mass.
Pellet presses, time study apparatus

Blake Co., Edward, 437 Cherry St., West Newton 65, Mass.
Dimensional gages

Bliley Electric Co., 200 Union Station Bldg., Erie, Pa.
Quartz piezo-electric crystals

Bliss & Co., Inc., John, 84 Pearl St., New York 4, N. Y.
Marine instruments

Block Mfg. Co., Fairy Rd., Parktour, Md.

Bock Machine Co., 3618 Colerain Ave., Cincinnati 23, Ohio
Erichsen sheet metal testing machine

Bodine Electric Co., 2254 W. Ohio St., Chicago 12, Ill.
Motors, all types of windings from 1/2000 to 1/6 hp. speed reducers & nonreducer motors

Boehmke Optical Co., 3737 Bird Road, Miami 33, Fla.
Precision optical manufacturers

Boekel & Co., Wm., 509-519 Vine St., Philadelphia 6, Pa.
Laboratory apparatus

Boeckeler Instrument Co., 31 E. Rillito St., Tucson, Ariz.
Precision levels, toolmaker's microscopes and time meters

**Bogue Electric Mfg. Co., 75 Iowa Ave., Paterson 3, N. J.**
Voltage and speed regulators; magnetic amplifiers and controllers; AC and DC motors and generators; switchboards
**(See advertisement on page 37)**

Bolsey Corp. of America, 118 E. 25th St., New York, N. Y.
Optical equipment, cameras and projectors

**Boonton Radio Corp., P. O. Box 390, Boonton, N. J.**
Radio test instruments
**(See advertisement on page 111)**

**Booth Co., Arthur E., 4124 Beverly Blvd., Los Angeles 4, Calif.**
Portable meter testers
**(See advertisement on page 107)**

Borg Corp., Geo. W., Equip. Div., 120 S. Main St., Janesville, Wis.
Potentiometer voltage dividers, slide wire rheostats

Borden Engineering Co., New Providence, N. J.
Ground resistance meters, pipe locators, signal generators

Boston Auto Gage Co., 70 West St., Pittsfield, Mass.
Liquid level gages and allied lines

Bostrom-Brady Mfg. Co., Stonewall & Bailey Sts., S.W., Atlanta, Ga.
Surveying instruments

Boulin Instrument Corp., 65 Madison Ave., New York 16, N. Y.
Chronometric hand tachometers, wound stroboscopes, electrical stroboscopes, speed indicators & portable & stationary tachometers

Bowen & Co., Inc., 4712 Bethesda Ave., Bethesda 14, Md.
Cement testers

Bowser, Inc., 1302 E. Creighton Ave., Fort Wayne 2, Ind.
Liquid meters

Bowser Technical Refrigeration, Terryville, Conn.
Testing cabinets, low temperature, high altitude, relative humidity

Boylston Steam Specialty Co., 116 W. Illinois St., Chicago 10, Ill
Regulating valves

Brabender Corp., 244 Saddle River Rd., Rochelle, Park, N. J.
Industrial measuring & control apparatus for plastic & viscous materials; semi-automatic moisture testers

Bradley Laboratories, Inc., 168 Columbus Ave., New Haven 10, Conn.
Photoelectric cells

Bradshaw Instruments Co., 42 Flatbush Ave., Brooklyn 17, N. Y.
Electrical instruments

Brady Co., W. H., 16 E. Spring St., Chippewa Falls, Wis.
Markers, labels, safety signs

**Branson Instruments, Inc., 436 Fairfield Ave., Stamford, Conn.**
Thickness gages, tube & sheet metal
**(See advertisement on page 131)**

Braun Corp., 2260 East 15th St., Los Angeles 21, Calif.
Chemicals & laboratory supplies

Braun-Knecht-Heimann Co., 1400 Sixteenth St., San Francisco, Calif.
Laboratory supplies

Bray Optical Co., 3445 W. 1st. St., Los Angeles 4, Calif.
Lenses, prisms & optical instruments

Breeze Corporation, 41 South 6th St., Newark 7, N. J.
Multiple connectors; radio ignition shielding

Bridgeport Thermostat Div., Robertshaw-Fulton Controls Co., 1225 Connecticut Ave., Bridgeport, Conn.
Metallic bellows and thermostats

Brigham Co., R. B., 624 Southard Ave., Toledo 2, Ohio
Photoelectric controls

**Bristol Company, Waterbury 91, Conn.**
Recording & automatic controlling instruments for pressure, vacuum, draft, absolute pressure, humidity, liquid level, flow, pH value, temperature (pyrometers & thermometers) & speed. Included are recording barometers, voltmeters, ammeters, wattmeters, dairy instruments, machine operation, motion & operation recorders, control valves, telemetering instruments, process cycle controllers, coordinated process control, time-temperature and time-pressure controllers, potentiometers, air operated & electric controllers & thermal converters. Dilatometers & combustible gas & vapor detectors
**(See advertisements on pages 77, 85, 109, 110, 118, 137, 158)**

Brodie Co., Inc., Ralph N., 61st & Lowell Sts., Oakland 8, Calif.
Positive displacement petroleum meters & accessories

Brooke Engineering Co., Inc., 4517 Wayne Ave., Philadelphia 44, Pa.
Electrically actuated pressure & flow controllers

Brookfield Engineering Laboratories, 2 Porter St., Stoughton, Mass.
Synchro-Lectric viscosimeter

Brooks Rotameter Co., Box 511, Lansdale, Pa.
Flowmeters

Brown Geophysical Co., 5300 Brownmay Rd., Houston 19, Tex.
Instruments for measuring earth's gravitational field

Brown Electro-Measurement Corp., 4635 S.E. Hawthorne Blvd., Portland 15, Calif.
Electrical instruments and components

Brown & Sharpe Mfg. Co., Providence 1, R. I.
Machine shop instruments

Browne-Morse Co., Muskegon, Mich.
Laboratory furniture

Browning Laboratories, Inc., 750 Main St., Winchester, Mass.
Frequency meters, signal generators, cathode-ray oscillographs

Bruning Co., Inc., Chas., 4754 Montrose St., Chicago 41, Ill.
Drawing & surveying instruments

Brunson Instrument Co., 1405 Walnut St., Kansas City 6, Mo.
Surveying instruments

**Brush Development Co., 3405 Perkins Ave., Cleveland 14, Ohio**
Magnetic direct writing oscillographs, a.c., d.c., and strain-gage amplifiers, uniformity, transient, and surface analyzers, deviation test bridges, sound level recorders, oscillators, and acoustical measurement instruments. "Hypersonic" equipment
**(See advertisement on page 5)**

Bryant Chucking Grinder Co., Springfield, Vt.
Screw thread gages

Buchanan Electrical Products Corp., 1290 Central Ave., Hillside, N. J.
Terminal blocks, terminals

Bud Radio, Inc., 2118 East 55th St., Cleveland, Ohio
Electronic components

**Buffalo Meter Co., 2917 Main St., Buffalo 14, N. Y.**
Liquid meters for measurement of cold water, hot water, oils, chemicals. Integrating registers, cumulative, setback, or predetermined control.
**(See advertisement on page 91)**

Buffalo Scale Co., 1200 Niagara St., Buffalo 13, N. Y.
Scales

Builders-Providence, Inc., 345 Harris Ave., Providence 1, R. I.
Instruments for indicating, recording, controlling flow, liquid level, pressure, temperature, and weight

Bullard Co., E. D., 275 Eighth St., San Francisco 3, Calif.
Gas leak detectors

Bunnell Company, J. H., 81 Prospect St., Brooklyn, N. Y.
Relays & switches

**Burgess Battery Co., Freeport, Ill.**
Dry Batteries
**(See advertisement on page 4)**

Burke Electric Co., 8544 Grand River Ave., Detroit 4, Mich.
Fractional horsepower motors

**Burke & James, Inc., 321 S. Wabash; Chicago 4, Ill.**
Photographic equipment for research and laboratory departments
**(See advertisement on page 101)**

Burke, Louis, 41 John St., New York, N. Y.
Stop watches and chronometers

**Burling Instrument Co., 5 Vose Ave., South Orange, N. J.**
Temperature controls for laboratories, Industrial processes, furnaces & ovens. (-100° to 1400°F.) Standard tubes or special alloys & ranges.
**(See advertisement on page 28)**

Burlington Instrument Co., 214½ North 4th St., Burlington, Iowa
Electrical control apparatus

Burndy Engineering Co., 47 West Main St., Stamford, Conn.
Connectors, plugs and jacks

Burrell Corp., 2223 Fifth Ave., Pittsburgh 19, Pa.
Scientific instruments & laboratory supplies

Burrows Equipment Co., 1316 Sherman Ave., Evanston, Ill.
Moisture testers

Burton Mfg. Co., 11201 W. Pico Blvd., Los Angeles 64, Calif.
Microscopic accessories & bank & turn indicators

B. W. Controller Corp., 2200 E. Maple Rd., Birmingham, Mich.
Floatless liquid level controls

## C

Cadillac Gage Co., 20316 Hoover Road, Detroit 5, Mich.
Dimensional gages

Cady & Co., E. J., 134 N. LaSalle St., Chicago 2, Ill.
Non destructive testers for physical properties

Cal-Astro Optical Labs., 711 N. Lake St., Pasadena 6, Calif.
Optical instruments and components

Calculagraph Co., 300 Sussex St., Harrison, N. J.
Elapsed time indicator

Calibron Products, Inc., 51 Lakeside Ave., West Orange, N. J.
Special apparatus

Calidyne Co., 751 Main St., Winchester, Mass.
Accelerometers and vibration pickups

Callahan & Co., E. J., 14 W. Barre St., Baltimore 1, Md.
Laboratory supply house

Calta Glass Wks., 2158 Ogden Ave., Chicago 12, Ill.
Scientific glassware

Cambridge Instrument Co., Inc., 3732 Grand Central Terminal, New York 17, N. Y.
Scientific & industrial instruments

Cameron Surgical Specialty Co., 666 W. Division St., Chicago 10, Ill.
Surgical instruments

Campbell Co., J. A., 645 Wardlow Rd., Long Beach 7, Calif.
Thermometer wells & automatic controllers

Canadian Radium & Uranium Corp., 630 Fifth Ave., New York 20, N. Y.
Luminous, phosphorescent and flourescent paints

**Cannon Electric Co., 3209 Humboldt St., Los Angeles 31, Calif.**
Multiple circuit connectors for instruments
**(See advertisement on page 55)**

Cargille Scientific, Inc., 118 Liberty St., New York 6, N. Y.
Chemical laboratory & photographic devices. Immersion liquids for inspecting glass & quartz

Carboloy Dept., General Electric Co., 11155 East 8 Mile St., Detroit 32, Mich.
Permanent magnets, magnetic alloys

Carter Parts Co., 213 Institute Place, Chicago 10, Ill.
Relays, resistors, rheostats & switches

Carver, Fred S., 345 Hudson St., New York 14, N. Y.
High pressure testing devices

Cash Co., A. W., P. O. Box 575, Decatur B, Ill.
Combustion control instruments

**Central Scientific Co., 1700 Irving Park Blvd., Chicago, Ill.**
Scientific instruments & laboratory apparatus
**(See advertisement on page 85)**

Centralab Div., Globe Union Inc., 900 E. Keefe Ave., Milwaukee 1, Wis.
Capacitors, rheostats, resistors & switches

**Century Geophysical Corp., 1333 N. Utica Ave., Tulsa 6, Okla.**
Geophysical instruments
**(See advertisements on pages 14, 15)**

Chace Co., W. M., 1600 Beard Ave., Detroit 9, Mich.
Thermostatic bimetals

Chandler & Stedman, 398 Newton St., Waltham 54, Mass.
Special laboratory apparatus

Charvos-Roos Corp., 185 Hackensack St., East Rutherford, N. J.
Drawing instruments

**Chatillon & Sons, John, 85 Cliff St., New York 7, N. Y.**
Iso-elastic springs
**(See advertisement on page 180)**

**Chelsea Clock Company, 284 Everett Ave., Chelsea, Mass.**
Clocks & clock movements
**(See advertisement on page 161)**

Chemical Rubber Co., 2310 Superior, East, Cleveland 14, Ohio
Laboratory supplies

Cherry-Channer Corp., 1488 Skokie Blvd., Highland Park, Ill.
Snap switches

Chicago Apparatus Co., 1735 No. Ashland Ave., Chicago 22, Ill.
Laboratory supplies

Chicago Condenser Co., 3255 W. Armitage Ave., Chicago 47, Ill.
Capacitors

Chicago Dial Indicator Co., 180 N. Wacker Dr., Chicago 6, Ill.
Machinist's dial indicators

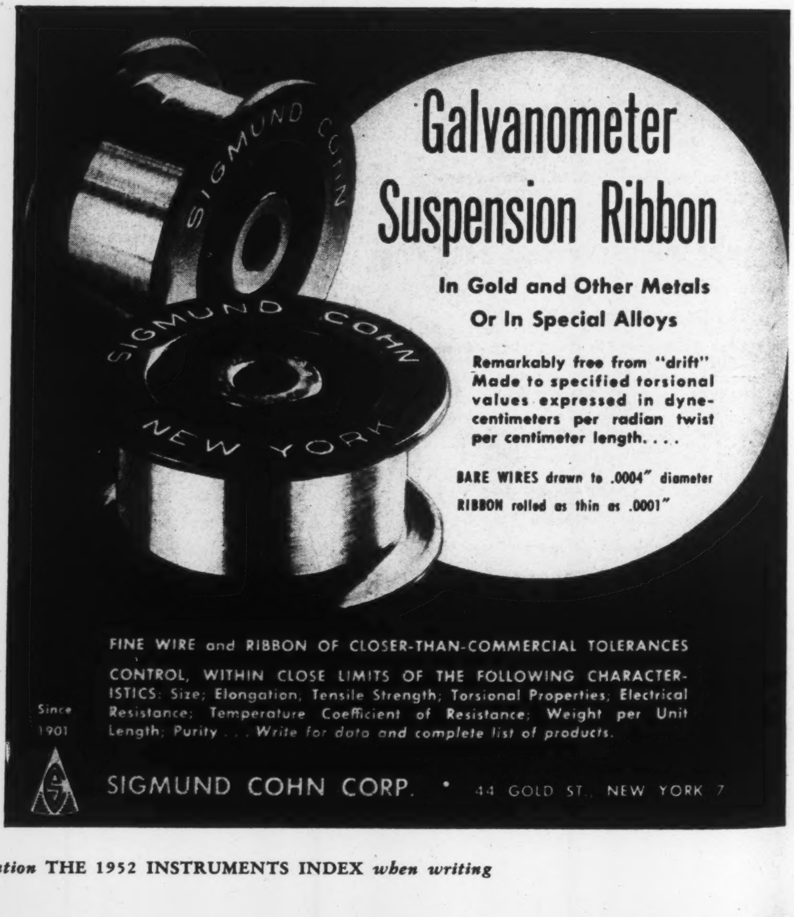
Chicago Electric Tachometer Co., 111 Lake St., Madison, Ohio
Electric tachometers; portable tachometers, speed indicators

Chicago Electronic Engineering Co., 3223 W. Armitage Ave., Chicago 47, Ill.
Transformers

Chicago Industrial Inst. Co., 536 W. Elm St., Chicago 10, Ill.
Radio, electronic & industrial test equipment

Chicago Metal Hose Corp., 1309 S. 3rd Ave., Maywood, Ill.
Metal bellows

Chicago Surgical & Electrical Co., 324 W. Superior St., Chicago 10, Ill.
Laboratory supplies



Galvanometer Suspension Ribbon

In Gold and Other Metals
Or In Special Alloys

Remarkably free from "drift"
Made to specified torsional values expressed in dyne-centimeters per radian twist per centimeter length. . . .

BARE WIRES drawn to .0004" diameter
RIBBON rolled as thin as .0001"

FINE WIRE and RIBBON OF CLOSER-THAN-COMMERCIAL TOLERANCES

CONTROL, WITHIN CLOSE LIMITS OF THE FOLLOWING CHARACTERISTICS: Size; Elongation; Tensile Strength; Torsional Properties; Electrical Resistance; Temperature Coefficient of Resistance; Weight per Unit Length; Purity . . . *Write for data and complete list of products.*

Since 1901

SIGMUND COHN CORP. • 44 GOLD ST., NEW YORK 7

**need help**

**WITH YOUR SUB-ASSEMBLIES?**

**CHELSEA is equipped to deliver the complete *Precision Package* . . . or any part of it:**

**-ENGINEERING**

**-MANUFACTURING**

**-ASSEMBLING**

Whether the application is electrical, mechanical or a combination of both, you'll find that Chelsea engineers have what it takes in terms of experience. Their know-how derives from designing and manufacturing parts to closest tolerances, creating Chelsea instruments of the keenest precision — for measuring time, computing intricate intervals, controlling, recording — *acting* higher in the stratosphere, deeper under the sea, than human control is able to go!

Whatever your assembly or sub-assembly problem, it is worth your while to consult Chelsea. A letter, telephone call, or telegram to Chelsea may solve your biggest problem!

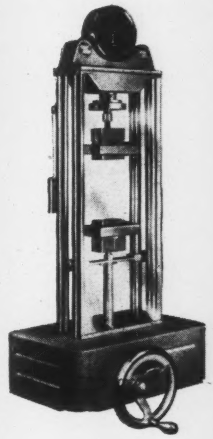
Units that Chelsea has engineered and produced for many of America's leading industrialists include the following: temperature, flow, and water stage recorders; photographic remote controls, cylinder chart clocks, night watchmen's clocks, time clocks, and a wide variety of fully jewelled controls of highest precision.

*Chelsea* CLOCK CO.
71 Everett Avenue Chelsea, Mass.

---

## DILLON PRECISION PRODUCTS

ILLUSTRATED BELOW ARE A FEW OF THE MORE POPULAR DILLON INSTRUMENTS WHICH ARE IN USE IN LEADING PLANTS, BY SCHOOLS AND UNIVERSITIES AND BY MOST GOVERNMENTAL DEPARTMENTS. ALL ARE AVAILABLE FOR *PROMPT* SHIPMENT.



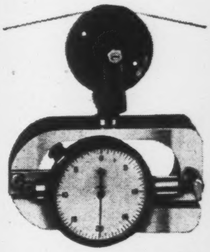
### MODEL L UNIVERSAL TESTER

A high capacity universal tester for tensile, compression, transverse and shear work. Portable and easy to operate. For cloth, wire, springs, wood, metals, castings, plastics, etc.

Calibrated with elastic proving ring. Extreme accuracy. Available in 7 different capacities from as low as 0-250 lbs. up to 0-10,000 lbs. A 5" dia. or 10" dia. dial is optional.

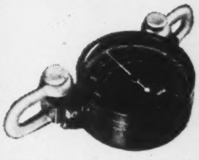
Handles standard round or flat specimens with ease and simplicity. Regular grips for flat specimens can be removed in seconds and replaced with any type of special gripping fixture.

Standard model is hand operated. Used on work bench. Can be supplied motorized to ASTM specs. if desired. America's *finest* low cost tester!



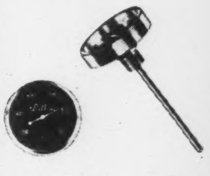
### MECHANICAL PRESSURE GAUGE

This versatile instrument has unlimited application. For measuring mechanical, static or moving loads. Wide variety of adapting fixtures may be used with it. Illus. shows moving wire passing over pulley to indicate tension. 9 capacities. Jeweled dial indicator. From as low as 0-10 lbs. up to 0-5,000 lbs.



### TRACTION DYNAMOMETER

Ideal for shop, laboratory or field use in determining static loads or tensile strains on objects that are too large or cumbersome for conventional testing machines. Reads directly in lbs. Thirteen different capacities from as low as 0-500 lbs. up to 0-100,000 lbs. More than 100 different uses.



### DIAL THERMOMETERS

Accurate to 1% of the range over entire scale. Stainless steel construction. Large, easy-to-read dials in 2¼", 3" or 5" diameters. Wide variety of working ranges to suit every requirement in both Fah. and Centigrade. Provided with ½" or ¼" mounting nuts, and stem lengths from 3" up to 80". Special ranges or dial layouts to order.

Dillon
WEIGHT INDICATOR

### WEIGHT INDICATOR

Fits directly on crane or hoist hook and weighs lightest or bulkiest objects with equal ease. 16" diameter dial provides fine divisional breakdown. Large eye-bolt at top and full swiveling hook at bottom. Extremely accurate. Calibrated with certified dead weights. Capacities from 0-250 lbs. up to 0-20,000 lbs. Fully dampened, has tare load compensation. Easily carried by one man yet extremely rugged. Effects real savings in time and money!

**W. C. DILLON & CO., INC.** 1421D S. CIRCLE AVE.
FOREST PARK, ILL.

**Write for Illustrated Literature on Any or All of the Above**

Chicago Transformer Corp., 3501 W. Addison St., Chicago 18, Ill.
Instrument & power transformers

Cincinnati Clock & Instrument Co., 1113 York St., Cincinnati 14, Ohio
Circuit breaker analyzer

Cincinnati Time Recorder Co., 1733 Central Ave., Cincinnati 14, Ohio
Time recorders

**Cinema Engineering Co., 1508 W. Verdugo Ave., Burbank, Calif.**
Electrical and electronic instruments and components
**(See advertisement on page 46)**

Circle Gauge Co., P. O. Box 2524, Hollywood 28, Calif.
Piston ring gages

Clare & Co., C. P., 4719 Sunnyside Ave., Jefferson Sta., Chicago, Ill.
Relays, electric counters & electro mechanical specialties

Clark Cooper Co., Palmyra, N. J.
Timers, alarms and controllers

Clark Instrument Co., Inc., 10202 Ford Road, Dearborn, Mich.
Hardness testers

Clark & Sons, Inc., Alvan, 58 Day St., West Somerville, Mass.
Optical & astronomical instruments

Clarke Insts. Div., National Electrical Machine Shops, Inc., 910 King St., Silver Spring, Md.
Electrical indicating instruments and accessories

**Clarkstan Corp., 11923 W. Pico Blvd., Los Angeles 64, Calif.**
Electronic equipment
**(See advertisement on page 90)**

Clarostat Mfg. Co., Inc., Dover, N. H.
Resistors

Clay-Adams Co., Inc., 141 East 25 St., New York 10, N. Y.
Angle & micro centrifuges, compact balances, analytical weights, microscope slides & cover glasses, glass & porcelain ink, tuning forks

Clebar Watch Co., 551 Fifth Ave., New York 17, N. Y.
Stop watches, timers & chronographs

Cleveland Fuel Equipment Co., 7316 Associate Ave., Cleveland 9, Ohio
Furnace controllers, pyrometers & gages

Clifford Mfg. Co. Div., Standard-Thomson Corp., 152 Grove St., Waltham 54, Mass.
Metallic bellows & diaphragms; thermostatic assemblies; packless valves

Climax Controls Div. see Black, Sivalls and Bryson, Inc.

Clippard Instrument Laboratory, Inc., 1125 Bank St., Cincinnati 14, Ohio
Electronic apparatus and electrical instruments

Clough-Brengle Co., 6014 Broadway, Chicago 40, Ill.
Electrical instruments, communication testing instruments

**Cohn Corp., Sigmund, 44 Gold St., New York, N. Y.**
Galvanometer suspension ribbon
**(See advertisement on page 160)**

Cole Co., H., 82 North High St., Columbus 15, Ohio
Surveying instruments

**Cole Instrument Co., 1320 S. Grand Ave., Los Angeles 15, Calif.**
Electrical instruments
**(See advertisements on pages 104, 120, 154)**

Coleman Instruments, Inc., 318 Madison St., Maywood, Ill.
Electrical measuring instruments for technical applications

Coleman Instrument & Mfg. Co., 716 Troost Ave., Tulsa 5, Okla.
Oscillographs

Collins Radio Co., Cedar Rapids, Iowa
Electronic apparatus

Columbia Electric Mfg. Co., 4519 Hamilton Ave., Cleveland 14, Ohio
Rheostats, instruments, shunts, switchboards & special electrical equipment

Combustion Control Corp., 77 Broadway, Cambridge, Mass.
Combustion controls

Commerce Pattern Foundry & Machine Co., 7450 Melville Ave., Detroit 17, Mich.
Balancing machines

Commercial Research Labs., Inc., 20 Bartlett St., Detroit 3, Mich.
Laboratory instruments for automotive, aircraft, railway & allied industries; air flow indicators, direct pressure & piezo-ray engine indicators, fuel flow indicators, magnetic gages, torsional vibration indicators (piezo-ray), recorders (torsiographs & recording instruments for car perfomance & riding comfort.

Communication Measurements Laboratory, 120 Greenwich St., New York 6, N. Y.
Testers, rectifiers, voltage regulators, communication measuring equipment

Compar Instrument Co., 455 Douglas Road, Holland, Mich.
Comparators, surface-finish microscopes and testers

Comtor Company, 83 Rumford Ave., Waltham 54, Mass.
Precision internal & external comparator-type diameter gages

Conant Laboratories, 6500 O St., Lincoln 5, Neb.
Dry disc rectifiers

Condenser Products Co., 7517 North Clark St., Chicago, Ill.
Capacitors

Conn, Ltd., C. G., Electronics Div., 1101 E. Beardsley Ave., Elkhart, Ind.
Stroboscopes

Connecticut Telephone & Electric Div., Great American Industries, Inc., Meriden, Connecticut
Electronic devices

Connelly Inc., 3154 S. California Ave., Chicago 8, Ill.
Gages & manometers, B T U indicator & $H_2S$ tester

**Conoflow Corp., 2100 Arch St., Philadelphia 3, Pa.**
Valves, automatic controls
**(See advertisements on pages 56, 58, 114, 148)**

Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 8, Calif.
Geophysical instruments, mass spectrometers, vibration measuring equipment

Continental Electric Co., Geneva, Ill.
Photoelectric tubes & equipment

Continental Equipment Co., Coraopolis, Pa.
Valves

Control Corporation, 718 Central Ave., Minneapolis 14, Minn.
Automatic & remote control equipment

Control Products, Inc., 306 Sussex St., Harrison, N. J.
Thermostatic switches

Cook Electric Co., 2700 Southport Ave., Chicago 14, Ill., Research Div., 1457 Diversey Pky., Chicago 14, Ill.
Electrical control devices, metal bellows, vapor meters & telephone protective & distributing apparatus, aircraft instrumentation, relays, pressure switches

Cook Research Laboratories, L. H., Box 696, Menlo Park, California
Precision testing instruments for oil industry, oil well cement testing equipment, combustible gas indicators, depth pressure recorders

Coors Porcelain Co., Golden, Colo.
Chemical & scientific porcelain

Corbin Screw Div., American Hardware Corp., New Britain, Conn.
Tachometers & speedometers

Cornell-Dubilier Electric Corp., Hamilton Blvd., So. Plainfield, New Jersey
Mica, dykanol, paper & wet & dry electrolytic capacitors

Corning Glass Works, Corning, N. Y.
Technical glassware

Coulter Electronics, 3023 W. Fulton Blvd., Chicago 12, Ill.
Amplifiers, microscopic particle and cell counters

**Counter and Control Corp., 5227 W. Electric Ave., Milwaukee 14, Wis.**
Circuit-control pre-set counters with automatic reset
**(See advertisement on page 64)**

**Cramer Co., Inc., R. W. Centerbrook, Conn.**
Interval timers, running time meters, time switches, signal control switches, time delay switches
**(See advertisement on page 141)**

**Crawford Fitting Co., 884 E. 140 St., Cleveland 10, Ohio**
Tubing and fittings
**(See advertisement on page 145)**

Crosby Steam Gage & Valve Co., 43 Kendrick St., Wrentham, Mass.
Safety & relief valves, gages, recorders, testers & steam engine indicators

Crown Industrial Products Co., 400 Borden Ave., Sycamore, Ill.

**Crystal Glass Tube and Cylinder Co., 439 East St., Chicago 19, Ill.**
Heat resisting, precision hose and other forms of tubing
**(See advertisement on page 84)**

Crystal Research Labs., Inc., 29 Allyn St., Hartford 3, Conn.
Capicators, quartz products, filters, flats, frequency meters, signal generators, mirrors, oscillators, r-f. oscillators, vitreous silica, time interval apparatus, vibration pickups

Curtin & Co., W. H., P. O. Box 118, Houston, Tex.
Laboratory supplies

Curtis Development & Mfg. Co., 4524 W. Madison St., Chicago 24, Ill.
Thermostats

Curtis Labs., 2718 Griffith Park Blvd., Los Angeles 27, Calif.
Optical instruments and components; color separation cameras

Cuthbert Co., Inc., 322 South Third St., Minneapolis 15, Minn.
Scientific grain, seed and food testing equipment

Cutler-Hammer, Inc., 315 North 12th St., Milwaukee 1, Wis.
Electric motor control, safety switches, motor drives valve operators, gas calorimeters, gas mixing & stabilizing control, resistors

Cyclohm Div., Howard Industries, 1215 State St., Racine, Wis.
Fractional-horsepower motors

Cyclotron Specialties Co., Morago 6, Calif.
Radioactivity equipment

## D

Daco Machine & Tool Co., 202 Tillary Co., Brooklyn, N. Y.
Aviation and military instruments

Daigger & Co., A., 159 W. Kinzie St., Chicago 10, Ill.
Laboratory supplies

Dale Instruments Div., Electronic Development Co. 2002 N. 51st St., Omaha 4, Neb.
Electrical instruments

Daniel Orifice Fitting Co., 3346 Union Pacific Ave., Los Angeles, Calif.
Orifice flowmeters and fittings

Darley & Co., W. S., 2810 Washington Blvd., Chicago 12, Ill.
Pipe locaters

Davidson Mfg. Co., 5142 Alhambra Ave., Los Angeles, Calif.
Astronomical telescopes

Daven Co., 191 Central Ave., Newark 4, N. J.
Attenuators, calibrating equipment for electrical instruments & resistors

**Davis Emergency Equipment Co., Inc., Davis Instruments Div., 80 Halleck St., Newark 4, N. J.**
Inflammable gas alarms
**(See advertisement on page 83)**

Davis Regulator Co., 2541 So. Washtenaw Ave., Chicago 8, Ill.
Valves

Dearborn Gage Co., 22038 Beech St., Dearborn, Mich.
Chronium plated gage blocks

Dearborn Scientific Co., 1228 W. Kenzie St., Chicago 22, Ill.
Optical flats

Defender Inst. & Reg. Co., 815 Clark St., St. Louis, Mo.
Industrial instruments

De Jur-Amsco Corp., 45-01 Northern Blvd., Long Island City 1, N. Y.
Photoelectric exposure meters, electrical, radio & photographic products

Delmhorst Instrument Co., 115 Cornelia St., Boonton, N. J.
Moisture detectors

Deming Indicator Co., 1016 Acorn Dr., Dayton 9, Ohio
Test indicators & dial indicators

Demuth Glass Works, Inc., Parkersburg, W. Va.

Denison Engineering Co., 1160 Dublin Rd., Columbus, Ohio
Presses

Denver Fire Clay Co., P. O. Box 5510, Denver 17, Col.
Specialized industrial control equipment for power plant & processing industries, laboratory specialties

Detect-O-Ray, 2622 N. Halsted St., Chicago 14, Ill.
Photoelectric counters

**Derbyshire, Inc., F. W., 157 High St., Waltham 54, Mass.**
Instrument lathes; micromills; chucks, etc.
**(See advertisement on page 87)**

Detecto Scales, Inc., 540 Park Ave., Brooklyn 5, N. Y.
Scales

Detectron Co., 5631 Coheunga Blvd., North Hollywood, Calif.
Leak and pipe detectors, radiation counters

De-Tec-Tronic Labs, Inc., 1711 Terra Cotta Place, Chicago 14, Ill.
Photoelectric instruments

Detroit Testing Machine Co., 9390 Grinnell Ave., Detroit 13, Mich.
Testing machines

De Vry Corporation, 1111 Armitage Ave., Chicago 14, Ill.
Scientific motion picture equipment & slide projectors

Dial Light Co. of America, Inc., 900 Broadway, New York 3, N. Y.
Dial lights

Diamond Power Specialty Corp., P. O. Box 415, Lancaster, Ohio
Industrial television

Dice Co., J. W., 1 Engle St., Englewood, N. J.
Gages, electrical instruments, non destructive inspection and testing equipment

Dickson Co., 7420 Woodlawn Ave., Chicago 19, Ill.
Furnace controls

**Dietert Co., Harry W., 9330 Roselawn Ave., Detroit 4, Mich.**
Sand testing equipment; immersion pyrometers, moisture testers, accessories for spectrographic laboratories
**(See advertisement on page 128)**

Dietzgen Co., Eugene, 2425 Sheffield Ave., Chicago 14, Ill.
Drafting & surveying instruments

**Dillon & Co., Inc., W. C., 1421 S. Circle Ave., Forest Park, Ill.**
Traction dynamometers, tensile machines, thermometers
**(See advertisement on page 161)**

Dimco-Gray Co., 207 E. 6 St., Dayton 2, Ohio
Timers and switches

Dirigo Compass & Instrument Co., Boeing Field, Seattle 8, Wash.

Distillation Products Industries, 755 Ridge Road West, Rochester 13, N. Y.
High vacuum pumps, low vapor pressure fluids & auxiliary equipment

Dittmore & Freimuth Co., 2517 E. Norwich St., Cudahy, Wis.
Electrical instruments, counters

DoAll Company, 254 N. Laurel, Des Plaines, Ill.
Gages, Brinnell hardness testers, precision tools

**Doelcam Corp., 56 Elmwood St., Newton, Mass.**
Precision instruments, gyroscopics, servomechanisms
**(See advertisement on page 123)**

Doerr Glass Co., Inc., 500 Peach St., Vineland, N. J.
Chemical glassware

Dollinger Corp., 11 Centre Park, Rochester 3, N. Y.
Instrument air filters

Doolittle Radio, Inc., 7421 Loomis Blvd., Chicago 36, Ill.
Frequency monitor

Dorothea Mechanisms, Gale, 81-01 Broadway, Elmhurst, L. I., N. Y.
Automatic controllers, motors, timers, switches

Dorr-Patterson Engineering Co., 3362 Wight Ave., Detroit 7, Mich.
Physical testing machines

Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
Electrical and electronic instruments

Douglas Automatic Controls Co., 4505 E. Firestone Blvd., South Gate, Calif.
Boiler controls

Douthitt Corp., 650 W. Baltimore Ave., Detroit 2, Mich.
Process cameras & diaphragm control for cameras

Dow Corning Corp., Midland, Mich.
Silicone fluids and greases for high and low temperature lubrication of instruments, stop-cock grease, high vacuum grease, lens cement, liquid dielectrics, diffusion pump oils

Drafto Co., Cochranton, Pa.
Drafting machines

**Drake Manufacturing Co., 1713 W. Hubbard St., Chicago 22, Ill.**
Dial & signal lights
**(See advertisement on page 104)**

Ducommun Co., M., 580 Fifth Ave., New York, N. Y.
Coil-spring stopwatches

Du Mont Labs., Inc., Allen B., Clifton, N. J.
Cathode-ray oscillographs, cathode-ray tubes, associated electronic equipment, television control, studio & transmitting equipment

Duncan Electric Mfg. Co., Lafayette, Ind.
A-c. & d-c. watthour meters, service & switchboard types; portable test meters, appliance meters & instrument transformers

Durakool Inc., 1010 Main St., Elkhart, Ind.
Mercury switches

Durant Manufacturing Co., 1914 N. Buffum St., Milwaukee 1, Wis.
Counting & measuring machines

Dusenbery, John, 150 Pine St., Montclair, N. J.
Designers and builders of nautical instruments and special mechanical devices

**Dwyer Mfg. Co., F. W., 317 S. Western Ave., Chicago 12, Ill.**
Portable & stationary draft gages, $CO_2$ indicators & combustion testing sets
**(See advertisements on pages 73, 90)**

Dynamatic Corp., 3307 14th Ave., Kenosha, Wis.
Variable speed drives, torque measuring equipment

# E

Eagle Signal Corp., 202 20th St., Moline, Ill.
Industrial control devices, traffic signal controllers & sign flashers

Eastern Industries, Inc., 296 Elm St., New Haven, Conn.
Laboratory pumps, stirrers & thermoregulators

Eastern Science Supply Co., 7-9 High St., Brookline, Mass.
Meteorological instruments

Eastern Specialty Co., 3617 N. 8th St., Philadelphia, Pa.
Testing equipment for checking & maintenance of all types of electricity meters such as watthour meters, demand instruments, etc. Special apparatus for load survey work.

Eastman Kodak Co., 343 State St., Rochester 4, N. Y.
Photographic equipment for laboratories, spectrographic, X-ray, etc.

Eastman Oil Well Survey Co., P. O. Box 408, Long Beach 1, Calif.
Underground surveying equipment

Eaton-Dikeman Co., Mt. Holly Springs, Pa.
Laboratory apparatus

Eberbach & Sons Co., Inc., 200 E. Liberty St., Ann Arbor, Mich.
Laboratory apparatus

Ebert Electronics Co., 185-09 Jamaica Ave., Hollis 7, N. Y.

Eby, Inc., Hugh H., 4700 Stenton Ave., Philadelphia 44, Pa.
Relays & radio parts

Eck & Krebs, 2709 40th Ave., Long Island City, N. Y.

**Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J.**
Aircraft electrical & mechanical accessories
**(See advertisements on pages 97, 113)**

Eder Instrument Co., 2293 N. Clybourn Ave., Chicago 14, Ill.
Pocket microscope

Edelmann & Co., E., 2332 Logan Blvd., Chicago 47, Ill.
Automotive test instruments

**Edin Co., 207 Main St., Worcester, Mass.**
Oscillographs and oscilloscopes
**(See advertisement on page 103)**

**Edison, Inc., Thomas A., Instrument Div., West Orange, N. J.**
Scaled-in-glass control devices, including thermostatic switches, fire detection thermostats, & timing relays. Hermetically sealed thermostatic valves. Special control equipment
**(See advertisement on page 65)**

Edwards, L. V., 32 Irving Place, Rockville Centre, N. Y.
Smoke-density instruments and alarms

Eicor, Inc., 1501 W. Congress St., Chicago 7, Ill.
Fractional H. P., geared, ungeared, synchronous, capacitor, and D. C. motors

Eitel-McCullough, Inc., San Bruno, Calif.
Electrical and electronic instruments and components

Eitzen Co., Louis C., 17 W. 60th St., New York 23, N. Y.
Extensometers

Electric Auto-Lite Co., Instrument & Gauge Div., Toledo 1, Ohio
Pressure & vacuum gages, speedometers, tachometers & thermometers

Electric Design & Mfg. Co., Burlington, Iowa
Electrical instruments

Electric Eye Equipment Co., Danville, Ill.
Automatic inspection devices

**Electric Hotpack Co. Inc., Melrose St. at Cottman Ave., Philadelphia 35, Pa.**
Designers and manufacturers of heat control and laboratory equipment
**(See advertisement on page 40)**

**Electric Indicator Co., 21 Parker Ave., Stamford, Conn.**
Synchronous motors, position indicators, level controls, signaling devices
**(See advertisement on page 95)**

Electric Regulator Corp., 50 Fay St., South Norwalk, Conn.
Current and frequency regulators

Electric Speed Indicator Co., 12234 Triskett Road, Cleveland 11, Ohio
Precision electric tachometers & remote position indicators

Electric Tachometer Corp., 2218 Vine St., Philadelphia 3, Pa.
Speed indicators & recorders, electric & mechanical counters

Electrical Facilities Inc., 4224 Holden St., Oakland 8, Calif.
Apparatus for electrical measuring & testing, including precision transformers, watthour meter and instrument transformer testing equipment; rectifier apparatus

Electrical Utilities Co., 2429 St. Vincent Ave., La Salle, Ill.

Electrimatic Div., Marsh Corp., J. P., 3501 Howard St., Skokie, Ill.
Automatic control valves & controls, regulating valves. Pressure, temperature & electrical actuation

Electrocon Corp., 219 Sunrise Highway West, Freeport, N. Y.
Vibration measuring instruments

Electro Engineering Products Co., 609 West Lake St., Chicago 10, Ill.
Instrument and servomechanism motors; signal generators, HF apparatus

Electro-Mec Laboratory, 225 Broadway, New York 7, N. Y.
Electrical and electronic components

Electro-Mechanical Instrument Co., 812 Chestnut St., Perkasse, Pa.
Electrical instruments

Electro-Mechanical Research, Inc., 64 Main St., Ridgefield, Conn.
Electrical and electronic instruments and components

**Electro Mechano Co., 261 E. Erie St., Milwaukee 2, Wis.**
Tachometers, precision drill press
**(See advertisement on page 126)**

**Electro-Medical Laboratory, Inc., South Woodstock, Vt.**
Neurological & Allied medical instruments & general electronic apparatus
**(See advertisement on page 53)**

Electro-Physics Co., Box 136, G.P.O., New York 1, N. Y.

**Electro Products Laboratories, Inc., 4501 N. Ravenswood Ave., Chicago 40, Ill.**
Battery eliminators & rectified A. C. devices
**(See advertisement on page 107)**

Electro-Tech Equipment Co., 309 Canal St., New
Ammeters, voltmeters, power analyzers, bridges
York 13, N. Y.

Electronic Apparatus Corp., 116 E. Jackson Blvd., Elkhart, Ind.
Mercury relays and switches

Electronic Associates, Inc., 61 Brighton Ave., Long Branch, N. J.
Aircraft and electrical instruments

Electronic Controls, Inc., 4521 Chestnut St., Philadelphia 39, Pa.
Electronic controllers and timers for counting, lighting, etc.

Electronic Development Lab., 2655 W. 19th St., Chicago 8, Ill.
Electronic apparatus

**Electronic Engineering Associates, Ltd., 778 El Camino Rd., San Carlos, Calif.**
Dynamic pressure measuring equipment
**(See advertisement on page 50)**

Electronic Instrument Co., 276 Newport St., Brooklyn 12, N. Y.
Electrical and electronic instruments

Electronic Mfg. Co., 140 S. Second St., Harrisburg, Pa.
Oscillators, voltmeters

Electronic Products Co., 5330 E. Olympic Blvd., Los Angeles 22, Calif.
Glass instruments & apparatus

Electronic Tube Corp., 1200 E. Mermaid Lane, Philadelphia, Pa.
Cathode ray oscillographs

Electrons, Inc., 127 Sussex Ave., Newark 4, N. J.
Gas-filled & grid-control rectifier tubes

Electyme Motor Products Corp., 565 W. Washington Blvd., Chicago 6, Ill.
Clocks and timers

Elematic Equipment Corp., 1150 West Marquette St., Chicago 21, Ill.
Pyrometers

Elgin National Watch Co., Elgin, Ill., Industrial Products Dev., Aurora, Ill.
Watches, clocks, gages, gaging fixtures and micrometers

Ellison Draft Gage Co., 214 West Kenzie St., Chicago 10, Ill.
Manometers, draft gages, orsats

El-Tronics, Inc., 2647 N. Howard St., Philadelphia 33, Pa.
Electrical instruments, nuclear measuring devices

Emerson Apparatus Co., 171 Tremont St., Melrose, Mass.
Calorimeters

**Emery Company, A. H., Pine St., New Canaan, Conn.**
Pressure gages and testing machines
**(See advertisement on page 133)**

**Emmett Machine & Mfg. Co., 2249 Fourteenth St., S. W., Akron 14, Ohio**
Automatic controllers, timer and control valves
**(See advertisement on page 27)**

Empire Devices, Inc., 38-25 Bell Blvd., Bayside, N. Y.
High frequency apparatus

Engel, Inc., H. C. M., P. O. Box 233, Sidney, N. Y.
Small drills, small turned parts, millstones in sapphire and block grinding discs

Engelhard, Inc., Charles 900 Passaic Ave., East Newark, N. J.
Industrial instruments

Engineering Laboratories, Inc., 602 E. 4th St., Tulsa 1, Okla.
Seismic exploration equipment, vibration detectors, petroleum engineering devices, signaling equipment

**Engineering Research & Development Co., P. O. Box 166, Hinsdale, Ill.**
Precision instruments custom built
**(See advertisement on page 44)**

Engineering Research Associates, Inc., 1902 West Minnehaha Ave., St. Paul 4, Minn.

Engineers Specialty Div., Universal Engraving & Colorplate Co., 980 Elliott St., Buffalo 9, N. Y.
Optical comparators

Engis Equipment Co., 431 S. Dearborn St., Chicago 5, Ill.
Microscopes, surveying instruments, photoelectric color analyzers, optical flats and components

**Eppley Laboratory Inc., 12 Sheffield Ave., Newport, R. I.**
Thermopiles, pyrheliometers & standard cells for both industrial & laboratory use
**(See advertisements on inside front cover and page 51)**

Equipoise Controls, 100 Stevens Ave., Mount Vernon, N. Y.
Thermometers and tachometers

**Erb & Gray, 854 S. Figueroa St., Los Angeles 7, Calif.**
Optical, mechanical and electrical instruments
**(See advertisement on page 93)**

Erickson Specialty Co., 10 Cayuga St., Cohoes, N. Y.
Solenoid valves

Erie Resistor Corp., 644 West 12th St., Erie, Pa.
High frequency & molded resistors

E & S Optical Co., 911 Willow Ave., Hoboken, N. J.
Optical components

Ess Instrument Co., 96 S. Washington Ave., Bergenfield, N. J.
Industrial electronic instruments, photoelectric for smoke, flame, turbidity, color. Specific gravity indicators, recorders and controllers

Esterline-Angus Co., Inc., P. O. Box 596, Indianapolis 6, Ind.
Graphic recording & contract-making electrical instruments, time, speed, condensate purity, pressure & vacuum recorders, telemeters & portable current transformers

Eureka X-Ray Tube Corp., 3240 N. Kilpatrick Ave., Chicago, Ill.
X-ray tubes

**Evaporated Metal Films Co., Ithaca, N. Y.**
**(See advertisement on page 100)**

Ever Ready Thermometer Co., 1118 Bedford Ave., Brooklyn 5, N. Y.
Calorimeters, thermometers

Everson Mfg. Co., 214 W. Huron St., Chicago 10, Ill.
Chemical feeders

Exact Weight Scale Co., 944 West 5th Ave., Columbus 8, Ohio
Over-and-under weight scales & indicators for industrial purposes

## F

Fairbanks, Morse & Co., 600 So. Michigan Ave., Chicago 5, Ill.
Scales

Fairchild Camera & Inst. Corp., 88-06 Van Wyck Blvd., Jamaica 1, N. Y.
Instrument motors, servo-motors., navigational instruments, oscilloscope- and X-ray recording cameras.

Fairchild Recording Equipment Corp., 154 St. & 7th Ave., Whitestone, N. Y.
Magnetic tape recorder

**Falstrom Co., 92 Falstrom Ct., Passaic, N. J.**
Steel instrument panels, panel board assemblies, cubicles, totally enclosed weather & vermin proof instrument enclosures & steel cabinets.
**(See advertisement on page 25)**

Farnsworth Television & Radio, Fort Wayne, Ind.
Industrial television systems

Farrand Optical Co., Inc., Bronx Blvd. and E. 238 St., New York 66, N. Y.
Scientific instruments

Farrel-Birmingham Co., Inc., 25 Main St., Ansonia, Conn.
Calipers for checking roll diameters & gear tooth comparators

**Farris Engineering Corp., 436 Commercial Ave., Palisades Park, N. J.**
Safety and relief valves; naval and aircraft regulators; and hydraulic remote controls
**(See advertisement cn page 149)**

**Farris-Stacon Corp., Palisades Park, N. J.**
Automatic controllers, valves
**(See advertisement on page 63)**

Fassett Co., Inc., C. M., W. 21 Main Ave., Spokane 8, Wash.
Laboratory supplies

Fast & Co., John E., 3105 N. Crawford St., Chicago 41, Ill.
Capacitors

Fecker, J. W., 2016 Perryville Ave., Pittsburgh 14, Pa.
Astronomical instruments

Federal Anti- Capacity Switch Corp., 1200 Niagara St., Buffalo, N. Y.
Anti-capacity switches

Federal Classifier Systems, Inc., 127 N. Dearborn St., Chicago 2, Ill.
Particle size classifiers

Federal Instrument Co., 14-02 Broadway, Long Island City 2,N.Y.
Resistors

Federal Mfg. & Eng. Corp., 211 Steuben St., Brooklyn 5, N. Y.
Microscopes

**Federal Products Corp., 1144 Eddy St., Providence 1, R. I.**
Precision measuring instruments.
**(See advertisement on page 72)**

Federal Telephone and Radio Corp., 100 Kingsland Road, Clifton, N. J.
Radio transmitting and direction finding equipment, transmitting tubes, field intensity meters

Feiler Engineering Co., 8026 N. Monticello Ave., Skokie, Ill.
Electrical Instruments

Fellows Gear Shaper Co., Springfield, Vt.
Gear checking machines & involute measuring machines

**Fenwal, Inc., 3 Main St., Ashland, Mass.**
Industrial thermostats
**(See advertisement on page 26)**

Ferguson Co., 814 Ridgely St., Baltimore 30, Md.
Laboratory supply house

Ferner Co., R. Y., 110 Pleasant St., Malden, Mass.
Precision instruments

**Ferrier Engineering, 24 Benton St., Springfield, Mass.**
Special instruments; test stands for automatic and diesel industries
**(See advertisement on page 127)**

Ferranti Electric, Inc., 30 Rockefeller Plaza, New York 20, N. Y.
Electrical instruments

Ferris Instrument Corp., Boonton, N. J.
Laboratory & production testing equipment, radio noise & field strength meters & special electrical instruments

Fidelity Machine Co., 3906 Frankfort Ave., Philadelphia, Pa.
Abrasion testers

Field Electrical Instrument Co., 8 North Manheim Blvd., New Paltz, N. Y.
Electrical instruments

Fielden Instrument Corp., 2920 N. 4th St., Philadelphia 33, Pa.
Automatic controllers, electrical instruments

Fischer & Porter Co., 37 County Line Road, Hatboro, Pa.
Rotameters, sight flow meters, automatic flow controllers, precision optical cells, precision bore glass tubing & special precision glass apparatus.

**Fish-Schurman Corp., 68 Portman Rd., New Rochelle, N. Y.**
Scientific instruments, optical, technical & scientific glass & porcelain
**(See advertisement on page 98)**

Fisher Governor Co., Marshalltown, Iowa
Motor control valves & regulators

Fisher-Pierce Co., 70 Ceylon St., Boston 21, Mass.
Photoelectric controls, relays, timers

**Fisher Research Laboratory, Box 640, Palo Alto, Calif.**
Leak detector & pipe finder. Electronic equipment
**(See advertisement on page 104)**

Fisher Scientific Co., 711 Forbes St., Pittsburgh 19, Pa.
Standard & special equipment & instruments for chemical, biological & metallurgical laboratories

Flader, Inc., Fredric, 583 Division St., North Tonawanda, N. Y.
Aircraft Instruments

Fleischauer & Son, F., 89-36 187 Place, Hollis, L. I., N. Y.
Instrument makers

Fillo Sales & Engineering Co., 4401 Chouteau Ave., St. Louis 10, Mo.
Automatic control and combustion safety devices

**Flexible Valve Corp., 400 Commercial Ave., Palisades Park, N. J.**
Automatic valves
**(See advertisement on page 148)**

Flight Research Engineering Corp., P. O. Box 1-F, Richmond 1, Va.
Servomechanisms and automatic control systems

Fonda Gage Co., 53 Daly St., Stamford, Conn.
Gage blocks

**Food Technology, Inc., 5903 NW Highway, Chicago 31, Ill.**
Temperature and humidity chambers, testing apparatus
**(See advertisement on page 53)**

**Ford Engineering Co., 134 N. Second Ave., Upland, Calif.**
Voltage dividers
**(See advertisement on page 106)**

Ford Instrument Co., 31-10 Thomson Ave., Long Island City 1, N. Y.
Airbourne and ground instruments, automatic controllers, servomechanisms

Ford Regulator Valve Co., 403 Broome St., New York 13, N. Y.
Regulating valves

Foster Engineering Co., 835 Lehigh Ave., Union, N. J.
Control valves

**Foxboro Co., Foxboro, Mass.**
Indicating, recording & controlling instruments for pressure, temperature, humidity, level & flow
**(See advertisement on page 23)**

Fox Valley Instrument Co., Ingelside, Ill.
Industrial and automatic service instruments

Fraser Development Laboratory, P. O. Box 73, Huntington Station, N. Y.
Fluxometer for measuring magnetic flux in gauss

**Freas Glass Works, Francis L., 146 E. 9th St., Conshohocken, Pa.**
Hydrometers, thermometers & glass instruments
**(See advertisement on page 136)**

Fredericks Co., George E., Bethayres, Pa.
Glass instruments & apparatus

Freed Transformer Company, 1718 Weirfield St., Brooklyn 27, N. Y.
Transformers

Frick Co., Inc., Waynesboro, Pa.
Float valve controls & electric controls, refrigerating & air conditioning machinery

Friez Instrument Div., Bendix Aviation Corp., Towson 4, Md.
Temperature & humidity controls, gas & stoker controls, damper motors, electrical relays, temperature & humidity indicators & recorders, psychrometers, draft gages, anemometers, $CO_2$ analyzers

Fuess, Inc., R., 39 West 60th St., New York 23, N. Y.
Scientific instruments

Fuel Watchman, 77-29 138 St., Flushing, L. I., N. Y.

Fulcrum Oil Company, Franklin, Pa.
Instrument oils

Fuller Co., 110 Bridge St., Catasauqua, Pa.
Bulk material level controllers

Fulton Sylphon Div., Robertshaw-Fulton Controls Co., Knoxville 4, Tenn.
Temperature & pressure regulators, sylphon bellows; thermostat assemblies; diesel controls; automobile thermostats; air conditioning controls

Furnas Electric Co., 300 McKee St., Batavia, Ill.
Pressure controls

Furst Electronics, 14a S. Jefferson St., Chicago 6, Ill.
Electronic instruments

## G

Gadgets, Inc., 3629 N. Dixie Drive, Dayton 4, Ohio
Airbourne and ground instruments, testing chambers

**Gaertner Scientific Corp., 1201 Wrightwood Ave., Chicago 14, Ill.**
Measuring instruments including toolmaker microscopes, micrometer slides, micrometer microscopes, comparators, interferometers, spherometers, microscopes & telescopes for observation & inspection; time recording devices including chronographs & special devices; dividing machines for engraving linear & circular scales; goniometers; spectroscopic equipment & accessories
**(See advertisement on page 165)**

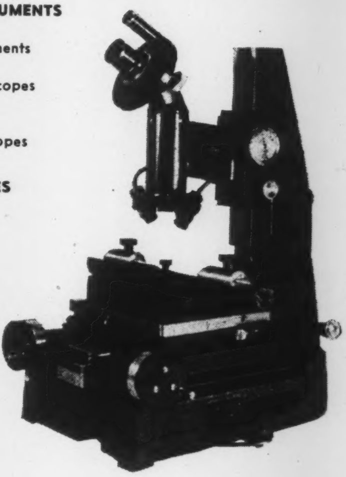
Gallien, R. P., 220 W. 5 St., Los Angeles 13, Calif.
Instrument lathes & tools

Gamma Instrument Co., Inc., P. O. Box 532, Great Neck, L. I., N. Y.
Micrographic cameras, micromanipulators

Gardner Laboratory, Inc., Henry A., 4723 Elm St., Bethesda 14, Md.
Scientific instruments, automatic inspection devices

Gas Appliance Specialties Co., 32-37 56th St., Woodside, New York, N. Y.
Gas regulators

Gaunt Industries, 827 Irving Park Road, Chicago 13, Ill.
Precision tools, lubrication devices for fine mechanisms



*Gaertner*

PRECISION OPTICAL AND MEASURING INSTRUMENTS

**MEASURING INSTRUMENTS**
- Cathetometers
- Creep Test Instruments
- Comparators
- Micrometer Microscopes
- Micrometer Slides
- Standard Scales
- Toolmaker Microscopes

**DIVIDING MACHINES**
- Circular
- Linear
- Manual
- Automatic

**INTERFEROMETERS**
- Michelson
- Fabry Perot
- Thermal Expansion

**POLARIZING**
- Compensators
- Polarimeters
- Polariscopes

**TEST INSTRUMENTS**
- Optical Benches
- Spherometers
- Spectrometers
- Microscopes
- Telescopes
- Refractometers

**SPECTROGRAPHS**
- Infrared
- Quartz
- Raman
- Spectroscopes
- Monochromators

**PHOTOMETERS**
- Martens
- Spectrophotometers
- Microdensitometers

**MISCELLANEOUS**
- Chronographs
- Laboratory Supports
- Precision Ruling

Write for Survey of Gaertner Instruments and Index to Current Literature.

THE GAERTNER SCIENTIFIC CORP.
1208 Wrightwood Ave. Chicago 14, U.S.A.

**Geier & Bluhm, Inc., 607 River St., Troy, N. Y.**
Mechanical devices & spirit level vials
**(See advertisement on page 88)**

Gelber, Samuel S., 162 N. Clinton St., Chicago 6, Ill.
Balancing machines

Genales, Andrew, 29 Second Ave., Nyack, N. Y.
Toolroom test indicators

General Biological Supply House, Inc., 761 East 69th Pl., Chicago 37, Ill.
Biological laboratory supplies

General Cement Mfg. Co., 919 Taylor Ave., Rockford, Ill.
Switches, cement tester, and spark plug tester

General Control Co., 1200 Soldiers Field Rd., Boston 34, Mass.
Electrical switches

**General Controls Co., 801 Allen Ave., Glendale 1, Calif.**
Pressure, temperature & flow control valves
**(See advertisement on page 6)**

**General Electric Co., 1 River Rd., Schenectady 5, N. Y.**
Electrical instruments & meters
**(See advertisement on page 20)**

General Electric Co., 1285 Boston Ave., Bridgeport 2, Conn.
Rectifiers & switches

General Electric Co., Carboloy Dept., 11177 E. 8 Mile Dr., Detroit 32, Mich.
Permanent magnets, magnetic alloys

General Electric Co., Chemical Dept., 1 Plastics Ave., Pittsfield, Mass.
Magnets and instrument oils

General Electric Co., Electronic Dept., 1001 Wolf St., Syracuse, N. Y.
Electronic equipment

General Electric Co., Lamp Dept., Nela Park, Cleveland 12, Ohio
Lighting sources

General Electric X-Ray Corp., 4855 W. Electric Ave., Milwaukee 14, Wis.
Medical, dental & industrial X-ray apparatus, accessories & supplies

General Physical Laboratory, 509 Fifth Ave., New York 17, N. Y.
Special light sources

General Power Plant Corp., 381 Fourth Ave., New York 16, N. Y.
Furnace controls

General Precision Lab., Inc., Pleasantville, N. Y.
Electrical and electronic instruments, testing equipment

General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Radio & electrical measuring instruments for laboratory & industrial use; stroboscopes noise measuring equipment, measuring & test equipment for electrical communication systems

General Regulator Corp., 165 Broadway, New York 6, N. Y.
Combustion, draft, liquid level & pressure controls

General Scientific Corp., 5151 West 65 St., Chicago 38, Ill.
Lenses & photoelectric cells

General Test Equipment Co., 38 Argyle Park, Buffalo 9, N. Y.
Pen size radio signal source, also special apparatus

**Genisco Inc., 2233 Federal Ave., Los Angeles 64, Calif.**
Testers for aviation instruments, guided missile instrumentation, components, digital-output converters and comparators
**(See advertisement on page 42)**

Geophysical Instrument, Div. Georator Corp., Key Blvd. & Nash St., Arlington 9, Va.
Instruments & accessories for prospecting for oil, minerals, water, bedrock; also equipment for making measurements in wells, radioactivity instruments

Geotechnical Corp., 3712 Haggar Drive, Dallas, Texas
Geophysical instruments

Gertsch Products, Inc., 11846 Mississippi Ave., Los Angeles 25, Calif.
Frequency standards, frequency meters, filters

G. & G. Precision Works, Inc., 5-33 Forty-eighth Ave., Long Island City 1, N. Y.
Mechanical optical & electrical precision instruments

**Giannini & Co., G. M., 285 West Colorado St., Pasadena 1, Calif.**
Aircraft instruments
**(See advertisement on page 106)**

Gilbert & Barker Mfg. Co., West Springfield, Mass.
Instrument housings

FRED C. HENSON
COMPANY

*specializing in*

CUSTOM BUILT
INSTRUMENTS

★

3311 E. COLORADO ST.
PASADENA 8, CALIFORNIA

ESTABLISHED 1925

Gilman Scientific Instrument Co., 527 S. Fair Ave., Pasadena 1, Calif.
Seismographs

Gilmore, E. R., Box 5718, Homewood Sta., Pittsburgh 8, Pa.
Gas leak stethoscopes

Gisholt Machine Co., Madison 3, Wis.
Static & dynamic balancing machines

Glass Engineering Laboratories, 601 O'Neill Ave., Belmont, Calif.
Laboratory apparatus; ultra-speed centrifuges

Gleason-Avery, Inc., Auburn, N. Y.
Furnace controls

Globe Industries, Inc., 125 Sunrise Place, Dayton, O.
Aircraft instrument testing equipment, aircraft interval timing istruments, aircraft photo equipment, automatic control instruments

Globe Phone Mfg. Corp., Reading, Mass.
Pipe locating equipment, leaky valve locators, hearing aids, secret phone or listening equipment for government investigating agencies

Globe Tool & Engg. Co., 410 Davis Ave., Dayton 3, Ohio
Dynamic balancing equipment

Glogau & Co., Inc., 1912 W. Birchwood, Chicago 26, Ill.
Calipers

G-M Laboratories, Inc., 4326 N. Knox, Cihcago 41, Ill.
Galvanometers and galvanometer relays

G. M. Manufacturing Co., 50 West 3 St., New York, N. Y.
Thermometers, hydrometers, psychrometers, hygrometers

Goerz American Optical Co., C. P., 317 East 34th St., New York 16, N. Y.
Photographic lenses, optical prisms & flats, and other optical units to specification

Gogan Machine Corp., 1440 E. 55 St., Cleveland 3, Ohio
Automatic hardness testers

Goldak Co., 1544 W. Glenoaks Blvd., Glendale 1, Calif.
Surveying instruments, pipe locators, leak detectors

Goodrich Co., B. F., 450 South Main St., Akron, Ohio
Vibration absorbers

Gordon Co., Claud C., 3000 S. Wallace St., Chicago 16, Ill.
Pyrometers, metallurgical testing machines, thermocouples, thermocouple wire, lead wire, insulators

Gordon Machine & Tool Co., Inc., 1910 W. Atlantic St., Philadelphia 40, Pa.
Thermocouples; thermocouple wells

**Gorrell & Gorrell, Haworth, N. J.**
Equipment for biological & psychological work
**(See advertisement on page 140)**

**Gotham Instruments Div., American Machine & Metals, Inc., Dept. 2, 233 Broadway, New York 12, N. Y.**
Indicating dial & recording thermometers
**(See advertisement on page 29)**

Gotham Scientific Co., 106 Water St., New York 5, N. Y.
Laboratory supplies

Gothard Mfg. Co., 2110 Clear Lake Ave., Springfield, Ill.
Dynamotors, inverters, converters, pulse generators

**Gow-Mac Instrument Co., 22 Lawrence St., Newark 5, N. J.**
Thermal conductivity gas analyzers & gas analysis cells
**(See advertisement on page 81)**

Graflax Corp., 154 Claressa St., Rochester, N. Y.
Scientific cameras

Graham-Mintel Instrument Co., 735 Carnegie Ave., Cleveland 15, Ohio
Precision measuring instruments

**Gramer-Transformer Corp., 2734 N. Pulaski Rd., Chicago 39, Ill.**
Transformers: instrument, power, adjustable, phasing, regulating
**(See advertisement on page 142)**

Gray Instrument Co., 64½ W. Johnson St., Philadelphia 44. Pa.
Scientific instruments

Grayhill, Inc., 4524 W. Madison St., Chicago 24, Ill.
Switches

Green, Henry J., 1191 Bedford Ave., Brooklyn 16, N. Y.
Meteorological instruments

**Green Instrument Co., 383 Putnam Ave., Cambridge, Mass.**
Engraving machines
**(See advertisement on page 69)**

Greene Bros., Inc., 1810 Griffin St., Dallas 2, Texas
Laboratory supplies

Greenfield Tap & Die Corp., Greenfield, Mass.
Machine shop gages

Greiner, Inc., Emil, 20-26 N. Moore St., New York 13, N. Y.
Laboratory supplies

Griebel Co., E., 8 Wayne St., Carbondale, Pa.
Thermometers, hydrometers, chemical & laboratory glassware

Grieve-Henary Co., Inc., 1101 N. Paulina St., Chicago 22, Ill.
Laboratory ovens

Griner Co., A. J., 1827 McGee St., Kansas City 8, Mo.
Laboratory supplies

Griswold Mfg. Co., F. T., Lancaster Ave., Wayne, Pa.

Grove Regulator Co., 1190 67th St., Oakland 8, Calif.
Pump governors, pressure reducing & back pressure regulators for gas or liquid pressures to 6000 lbs.

**Guardian Electric Mfg. Co., 1621 W. Walnut St., Chicago 12, Ill.**
A-c and d-c relays
**(See advertisement on page 117)**

Gulton Mfg Corp., 212 Durham Ave., Metuchen, N. J.
Accelerometers, ballistocardiographs, precision capacitors

Gump Co., B. F., 1325 So. Cicero St., Chicago 50, Ill.

Gurley, W. & L. E., 514 Fulton St., Troy, N. Y.
Surveying & allied engineering instruments, paper testing & aeronautical navigation instruments & standard weights & measures

**Gustafson Mfg. Co., G. D., 5328 N. Kedzie St., Chicago 25, Ill.**
Instrument tools
**(See advertisement on page 142)**

G-V Controls Inc., 28 Hollywood Plaza, East Orange, N. J.
Relays, switches

# H

**Hagan Corp., Hagan Bldg., Pittsburgh 30, Pa.**
Combustion control equipment; flow meters, draft & pressure gages for law pressure gas & air measurements: recording, indicating & integrating in any combination
**(See advertisement on page 3)**

Haines Designed Products Corp., 117 N. Findlay St., Dayton 3, Ohio
Ultracentrifuges

Halldorson Co., 4500 Ravenswood Ave., Chicago 40, Ill.
Transformers: instrument, testing, adjustable, regulating

Halliburton Oil Well Cementing Co., Duncan, Okla.
Oil well surveying instruments

Hamiton Mfg. Co., Two Rivers, Wis.
Laboratory furniture

Hamilton Watch Co., Lancaster, Pa.
Chronometers & watches

Hammel-Dahl Co., 243 Richmond St., Providence, R. I.
Automatic control valves

Hand & Sons Co., John E., Atlantic & Washington Aves., Haddonfield, N. J.
Navigational instruments

Hankison Corporation, 1501 Beaver Ave., Pittsburgh 33, Pa.
Filter for instrument air

Hanovia Chemical & Mfg. Co., 90 Chestnut St., Newark 5, N. J.
Quartz mercury arc lamps

Hansen Co., Wm., 165 Silverbrook Ave., Niles, Mich.
Timers and clocks

Hanson Mfg. Co., Inc., Princeton, Ind.
Electric Motors, servomechanism components, clock movements

Hardwick, Hindle, Inc., 40 Herman St., Newark 5, N. J.
Resistors

Hart Mfg. Co., R. E., 635 S. Main St., Ann Arbor, Mich.
Production counters

Hart Moisture Gauges, see Kaydel Moisture Gauges

Hart Moisture Meters, Grand Central Terminal, New York, N. Y.
Moisture testers

Harvey Radio Laboratories, Inc., 447 Concord Ave., Cambridge, Mass.
Electronic apparatus

Harvey-Wells Electronics, Inc. Southbridge, Mass.
Aircraft navigational instruments

Hasler-Tel Co., 30 Vesey St., New York 7, N. Y.
Speed indicators, portable, chronometric

Hass Brothers Instrument Co., 6236 Ritchie Rd., Washington 19, D. C.
Barometers, altimeters, manometers

Hastings Instrument Co., P. O. Box 1275, Hampton, Va.
Consulting instrument engineers, special developments

Hathaway Instrument Co., 1315 S. Clarkson St., Denver 10, Colo.
Instruments & apparatus for electrical & mechanical measurements & control

Hawk Tool Engineering Co., Inc., Clarkston, Mich.
Controllers & testing devices

**Haydon Co., A. W., 232 N. Elm St., Waterbury 32, Conn.**
Relays and timers
**(See advertisement on page 43)**

Haydon Manufacturing Co., Torrington, Conn.
Synchronous Motors, automatic timers

Hayes Scientific Appliances, 202 N. Broadway, Urbana, Ill.
Scientific instruments

**Hays Corp., P. O. Box 299, Michigan City, Ind.**
Combustion instruments & automatic combustion controls
**(See advertisements on pages 61, 81, 83)**

Hayward Scientific Glass Co., 217 Magnolia St., Whittier, Calif.
Optical instruments and components

H-B Instrument Co., Inc., 2633 Trenton Ave., Philadelphia 25, Pa.
Thermometers & hydrometers, remote control equipment

HD Electric Co., 760 Osterman Ave., Deerfield, Ill.
Split core ammeters, demand meters

Hebler Co., W. O., Central at Long Ave., Hillside, N. J.
Electrical gas analyzers

Heil Corp., 210-214 S. 4 St., St. Louis 2, Mo.
Laboratory supplies

**Heiland Research Corp., 130 E. 5th Ave., Denver 9, Colo.**
Geophysical instruments, photoflash synchronizers, gas detectors, oscillographs, strain gages, vibration detectors, recording cameras & industrial instruments.
**(See advertisement on page 101)**

Heinrich Co., Carl, 677 Beacon St., Boston, Mass.
Astronomical instruments

**Heise Bourdon Tube Co., Brook Rd., Newton, Conn.**
Bourdon tube devices
**(See advertisement on page 74)**

Helicoid see American Chain & Cable Co.

**Helipot Corp., 916 Meridan Ave., South Pasadena 8, Calif.**
Rheostats, voltage dividing resistors
**(See advertisement on page 104)**

Heller Co., Gerald K., 1540 Ridgely St., Baltimore 30, Md.
Manual motor controls

Hellige, Inc., 3718 Northern Blvd., Long Island City,
Scientific instruments, laboratory & bacteriological supplies

Henderson & Co., H. B., East Liverpool, Ohio
Pyrometric cones

Henry Valve Co., Inc., 3215 W. North Ave., Melrose Park, Ill.
Control valves

Henschel & Co., Inc., John, 105 E. 29th St. New York 16, N. Y.
Drawing instruments

**Henson Co., Fred C., 3311 E. Colorado St., Pasadena, Calif.**
Electroscopes, optical instruments and components
**(See advertisement on page 166)**

Henszey Co., Watertown, Wis.
Feed water meters, flow indicators continuous blowdown, heat exchangers and boiler feed regulators. Also meters and flow indicators for corrosive chemicals.

Herbach & Rademan, Inc., 522 Market St., Philadelphia 6, Pa.
Electronic instruments

Herman Stone Co., 324 Harries Bldg., Dayton 2, Ohio
Precision granite surface plates

Herron Optical Co., 705 W. Jefferson Blvd. Los Angeles 7, Calif.
Lenses, mirrors and optical parts

Hetherington & Berner, 701 Kentucky Ave., Indianapolis 7, Ind.
Fluidometers

Hetherington & Son. Inc., Robert, 1200 Elmwood Ave., Sharon Hill, Pa.
Switches

Heusser Instrument Mfg. Co., 1388 S. State St., Salt Lake City 4, Utah
Analytical balances

Hevi Duty Electric Co., Milwaukee 1, Wis.
Electric furnaces

Hewlett-Packard Co., 395 Page Mill Road, Palo Alto, California
Electronic equipment

Hexacon Electric Co., 179 W. Clay Ave., Roselle Park N. J.
Electric soldering irons

Heyman Mfg. Co., 530 Michigan Ave., Kenilworth N. J.
Inspection instruments

H & H Thermostats, Inc., 682 Broadway, New York 12, N. Y.
Altimeters, recording thermometers, recorder ink for extreme temperatures

**Hickok Electric Instrument Co., 10519 Dupont Ave., Cleveland 8, Ohio**
Electric indicating instruments

Hiergesell & Sons, Wm., 295 Pearl St., New York 7, N. Y.
Thermometers & hydrometers

High Voltage Engineering Corp., 7 University Road Cambridge, Mass.
High voltage devices

Hills-McCanna Co., 3025 N. Western Ave., Chicago 18, Ill.
Diaphragm valves, metering and proportioning pumps

Hillyer Instrument Co., Inc., 54-60 Lafayette St., New York 13, N. Y.
Computers and inspection devices

Hoke, Inc., 148 S. Dean St., Englewood, N. J.
Regulators

Holtzer-Cabot Electric Div., National Pneumatic Co., Inc., 125 Amory St., Boston, Mass.
Fractional Horsepower Motors

Hopp Press, Inc., 460 W. 34 St., New York 1, N. Y
Nameplates, dial faces, scales, instruction plates

Houston Technical Laboratories, 2424 Branard St., Houston 6, Texas
Gravity meters for geophysical prospecting

Howe & French Inc., 99 Broad St., Boston 10, Mass.
Laboratory supplies

Howe Scale Co., Rutland, Vt.
Scales

Howland Optical Co., 29 Cottage Place, Nutley, N. J.
Optical flats lenses, magnifiers

Hufco Industries, 2815 W. Olive St., Burbank, Calif.
Relays

Huggins Labs., 700 Hamilton Ave., Menlo Park, Calif.
Laboratory instruments, industrial photoelectric instruments, fused quartz apparatus, colorimeters

Hull Mfg. Co., P. O. Box 246, Warren Ohio
Compasses

Humboldt Mfg. Co., 2014 N. Whipple St., Chicago 47, Ill.
Cement & concrete testers

Hunter Spring Co., Lansdale, Pa.
Special springs

Huppert Co., K. H., 6830 Cottage Grove Ave., Chicago, Ill.
Laboratory furnaces

**Hycon Mfg. Co., 2961 E. Colorado St., Pasadena 8, Calif.**
**(See advertisement on page 102)**

Hycor Co., Inc., 11423 Vanowen St., North Hollywood, Calif.
Electric and electronic components

Hydraulic Div., New York Air Brake Co. 420 Lexington Ave., New York, N. Y.
Hydraulic control systems

Hytron Radio & Electronics Corp., 76 Lafayette St., Salem, Mass.
Electronic tubes

## I

Ice Optical Co., Herchel C., 1003 North 11 St., Reading, Pa.
Lenses, mirrors, optical flats, telescopes

Ideal Industries, Inc., 1420 Park Ave., Sycamore, Ill.
Insulation testers & revolution counters

**Ideal Laboratory Tool & Supply Co., 3913 Evans Ave., Cheyenne, Wyo.**
Aircraft instrument test apparatus, sensitive needle valves
**(See advertisement on page 34)**

**Illinois Testing Laboratories, Inc., 420 N. LaSalle St., Chicago 10, Ill.**
Indicating pyrometers, resistance thermometers pyrometer controllers air velocity meters, metal detectors
**(See advertisement on page 13)**

Impact Register Co., 510 N. Neil St., Champaign, Ill.
Instruments for determining and recording impacts received by railroad cars and riding qualities of railroad cars, automobiles

Impact-O-Graph Corp., 1900 Euclid Ave., Cleveland, Ohio
Impact recorders

Imperial Brass Mfg. Co., 1200 W. Harrison St., Chicago 7, Ill.
Fittings, tubing cutters and benders

Indiana Steel Products Co., Valparaiso, Ind.
Instrument magnets

Inductograph Products Inc., 236 W. 55th St., New York, N. Y.
Regulated power supplies

Industrial Condenser Corp., 3243 N. California Ave., Chicago 18, Ill.
Oil paper & electrolytic capacitors

Industrial Control Co., Straight Path and Arlington Ave., Wyandanch, L. I., N. Y.
Electrical instruments, servo amplifiers

**Industrial Electronics, Inc., 8060 Wheeler St., Detroit 10, Mich.**
Cathode-ray oscillograph
**(See advertisements on pages 16, 17)**

Industrial Engineering Corp., Rea Bldg., Terre Haute, Ind.
Relays

Industrial Filter & Pump Mfg. Co., 5900 Ogden Ave., Chicago 50, Ill.
Salt spray testers

**Industrial Instruments, Inc., 17 Pollock Ave., Jersey City 5, N. J.**
Electrical measuring & test equipment
**(See advertisement on page 40)**

Industrial Nucleonics Corp., 1205 Chesapeake Ave., Columbus 12, Ohio
Nuclear instruments, inspection devices

**Industrial Pyrometer & Supply Co., Alton, Ill.**
Thermocouples
**(See advertisement on page 61)**

Industrial Scientific, Inc., 317 Nagle St., Houston 1, Texas
Laboratory supply house

Industrial-Scientific Supply Co., 1014 Taylor St., Fort Worth 2, Texas
Laboratory supplies

Industrial Timer Corp. 117 Edison Place, Newark 5, N. J.
Industrial timers, motor driven, with automatic reset. Controllers, signals, testing equipment for electrical parts (operation or life test)

**Industrol Corp., Roselle Park, N. J.**
Air dryers and gas sample dryers
**(See advertisement on page 43)**

Inferno Co., Box 1138, Shreveport 90, La.
Combustion instruments

**Ingersoll-Rand Company, Phillipsburg, Pa.**
Instrument air compressors
**(See advertisement on page 22)**

Instron Engineering Corp., 2, Hancock St., Quincy 71, Mass.
Testing machines

Instrumaster Industries, Inc., 110 Sherman Ave., New York 34, N. Y.
Drawing instruments

Instrument Development Labs., Inc., 163 Highland Ave., Needham Heights 94, Mass.
Photoelectric color analyzers

Instrument Electronics Corp., 104 W. Jefferson St., Falls Church, Va.
Electronic instruments

**Instrument Laboratories, 315 W. Walton Place, Chicago 10, Ill.**
Electrical testing sets
**(See advertisement on page 44)**

Instrument Laboratory Inc. P. O. Box 4098, Interbay Station, Seattle 99, Washington
Counting & indicating instruments

Instrument Repair & Mfg. Co., 1258-48th Ave., Oakland 1, Calif.
Diaphragm valves and controllers

Instrument Resistors Co., 1036 Commerce Ave., Union, N. J.
Instrument resistors

Instruments Corp., 4 N. Central Ave., Baltimore 2 Md.
Meteorological instruments

International Business Machines Corp., 590 Madison Ave., New York 22, N. Y.
Scales & time instruments

International Equipment Co., 1284 Soldiers Field Road, Brighton, Boston 35, Mass.
Analytical centrifuges

International Glass Corp., 119 S. Beverly Drive, Beverly Hills, Calif.
Lenses, prisms and optical parts

International Instruments, Inc., 486 Derby Ave., West Haven, Conn.
Electrical instruments

International Microscope & Art Co., 1670 West Ogden Ave., Chicago 12, Ill.
Microscopes

**International Rectifier Corp., 6809 S. Victoria Ave., Los Angeles 43, Calif.**
Photoelectric cells and dry disc rectifiers
**(See advertisement on page 114)**

International Register Co., 2620 W. Washington Blvd., Chicago 12, Ill.
Coin meters—timers for electric ranges & gas ovens

International Resistance Co., 401 N. Broad St., Philadelphia 8 Pa.
Metallized & wirewound fixed & variable resistors including high voltage & high frequency types

Islip Radio Mfg. Corp., Foot of Beech St., Islip, N. Y.
Amplifiers

Ithaca Scientific Instrument Co., Ithaca, N. Y.
Drawing instruments

# J

Jackson Electrical Instrument Co., 18 S. Patterson Blvd., Dayton 1, Ohio
Radio testing equipment

Jacobs Instrument Co., 4718 Bethesda Ave., Bethesda 14, Md.
Ballistic instruments

Jaeger Watch Co., Inc., 304 East 45th St., New York 17, N. Y.
Automobile clocks, timepieces for aviation and marine, chronomatic tachometers & true airspeed indicators

Jansson Gage Co., 19206 Glendale Ave. Detroit 23, Mich.
Gages; gage blocks—special, built up; flush pin and thread gages, carboloy or steel

Jardur Import Co., 874 Broadway, New York 3, N. Y.
Chronographs & stop-watches

Jarrell-Ash Co., 165 Newbury St., Boston 16, Mass.
Representatives for Adam Hilger, Ltd , manufacturers of optical instruments

J B L Instrument Co., Sycamore & Mill Rd. Clifton Heights, Pa.
Rotary instrument switches, transformer tapping, railway signal gear, decade resistance boxes

**J-B-T- Instruments, Inc., 443 Chapel St., New Haven 8, Conn.**
Electrical measuring & controlling instruments: pyrometers, thermocouples selector switches, potentiometers, resistance thermometers, laboratory instruments
**(See advertisement on page 156)**

**Jeffrey Mfg. Co., 795 N. 4 St., Columbus 16, Ohio**
Weighing, feeding, batching & proportioning equipment
**(See advertisement on page 69)**

Jenkins Bros. 80 White St., New York 13, N. Y.
Regulating valves

**Jerguson Gage & Valve Co., 87 Fellsway, Somerville 45, Mass.**
Precision gages & valves
**(See advertisement on page 72)**

**Jo-Bell Products, Inc., 4840 South St. Louis Ave., Chicago 32, Ill.**
Liquid level alarms, magnetic proximity switches
**(See advertisement on page 40)**

Johnson Co., E. F., Gothard Div., Waseca, Minn
Connectors, plugs, dial lights, etc.

Johnson Gage Co. 534 Cottage Grove Rd., Bloomfield, Conn.
Comparators & gages

Johnson Scientific Instrument Co., 2915 Maples Ave., Berwyn, Ill.
Biological instruments, instrument-repair tools

Johnson Service Co., 507 E. Michigan St., Milwaukee 2, Wisc.
Automatic temperature & humidity control for heating, cooling, ventilating, air conditioning & industrial processes

**Johnson-Williams, Ltd., Box 8, Palo Alto, Calif.**
Combustible gas indicators & alarm systems, portable & continuous, including accessories
**(See advertisement on page 82)**

Johnston & Jennings Company, 877 Addison Rd., Cleveland 14, Ohio
Depth gages, valves

Jones, Howard B. Div., Cinch Mfg. Co., 1026 S. Homan Ave., Chicago 24, Ill.
Connectors

Jones Electronics Co., M C., 96 N. Main St., Bristol, Conn.
Standing wave meter

Jones & Lamson Machine Co., Clinton & Whitmore Sts., Springfield. Vt.
Optical comparators

Jones-Motrola Corp. 432 Fairfield Ave., Stamford, Conn.
Tachometers, speed indicators & speedometers

Jones Optical Works, A. D., 2400 Massachusetts Ave., Cambridge, Mass
Lenses, light filters and optical parts

# K

Kahl Scientific Instrument Co., Inc., El Cajon, Calif.
Thermometer, hydrometer, psychrometers, hygrometers

Kalbfell Laboratories, Inc., 1076 Morena Blvd., San Diego 10, Calif.
Audio frequency equipment, bridges, capacitance meters

Kansas City Laboratory Supply Co., 1434 Wyandotte St., Kansas City 6 Mo.
Laboratory supplies

**Karn Chemical Equipment Co., 518 Dickson Ave., Pittsburgh 2, Penna.**
**(See advertisement on page 138)**

Karp Metal Products Co., Inc., 211-277 63 St., Brooklyn, N. Y.
Instrument panels

W. A. Kates Co., 430 Waukegan Rd., Deerfield, Ill.
Automatic flow and pressure controllers

Kauffman-Lattimer Co., 230 N. Front St., Columbus 16, Ohio
Laboratory supplies

Kay Electric Co., 14 Maple Ave., Pine Brook, N. J.
Electronic instruments

**Kaydel Moisture Gauges, 126 Liberty St., New York 6, N. Y.**
Moisture meters
**(See advertisement on page 94)**

Keckley Mfg. Co., 400 W. Madison St., Chicago 6 Ill
Steam and liquid control equipment

Keithley Instruments, 3868 Carnegie Ave., Cleveland 15, Ohio
Amplifiers

Kelley-Koett Mfg. Co., Instrument Div., 930 York St., Cincinnati 14, Ohio
Radioactive detectors

Kelley-Koett Mfg. Co., Inc., Covington, Ky.
X-Ray apparatus

Kellogg Switchboard & Supply Co., 6650 S. Cicero, Chicago 38 Ill.
Relays

Kent Cliff Laboratories, P. O. Box 696, Peekskill. N. Y.
Hardness testers

Kenyon Instrument Co., Inc., 1345 New York Ave. Huntington, L. I., N. Y
Airport & marine instruments

**Kepco Laboratories, 149-14 41st Ave., Flushing, L. I., N. Y.**
Radio test panels
**(See advertisement on page 1)**

Kessler Co., Walter H., 180 Lafayette St., New York, N. Y.
Thermometers and hydrometers

Kester Solder Co., 4201 Wrightwood Ave., Chicago 39, Ill.
Cored solders

Keuffel & Esser Co., Adams & Third Sts., Hoboken, N. J.
Surveying instruments

Kewaunee Mfg. Co., End of So. Center St., Adrian Mich.
Laboratory furniture

Keystone Carbon Co., Inc., Saint Marys, Pa.
Carbon resistors

**Kieley & Mueller Inc., 2013-2033—43 St., North Bergen, N. J.**
Pressure regulating & flow control devices
**(See advertisement on page 57)**

Kimble Glass Co., Vineland, N. J.
Glass apparatus, glass tubing, thermometers, hydrometers

King, Andrew, 519 Broad Acres Road, Narberth Pa.
Portable Brinell hardness tester

**King Engineering Corporation, Box 70, Ann Arbor, Mich.**
Liquid level indicators, distant reading
**(See advertisements on pages 73, 89)**

Kirk & Blum Manufacturing Co., 3120 Forrer St., Cincinnati 9, Ohio
Instrument panels and sheet metal assemblies

Klett Mfg. Co. 179 E. 87th St., New York 28, N. Y.
Colorimeters

Klipfel Valves Inc. Div. Hamilton Thomas Corp., 1001 Laurel Ave., Hamilton, Ohio
Regulating valves

Knights Company, James, Sandwich, Ill.
Crystals

Knopf Instrument Co., 250 Culver Ave., Jersey City, N. J.
Counters and vehicle instruments

Koch & Co., F. A. 72 Spring St. New York 12, N. Y.
Laboratory supplies

Koehler Instrument Co., 168-56 Douglas Ave., Jamaica 3, N. Y.

Kollmorgan Optical Co., 2 Franklin Ave., Brooklyn 11, N. Y.
Astronomical & optical instruments

Kollsman Instrument Div., Square D Co., 80-08—45th Ave., Elmhurst Long Island, N. Y.
Precision instruments for aircraft

Kontes Glass Co., Spruce St., Vineland, N. J.
Glass apparatus, instruments and parts

Krohn-Hite Instrument Co., 580 Massachusetts Ave., Cambridge 39, Mass.
Computers, nuclear instruments

Krouse Testing Machine Co., 573 E. 11th Ave., Columbus 3, Ohio
Fatigue testing machines

# L

L. A. B. Corp., P. O. Box 162, Summit, N. J.
Special instruments

Laboratory Construction Co., 1113-15 Holmes St. Kansas City 6, Mo.
Laboratory furniture & apparatus

Laboratory Equipment Corp., Box 352, St. Joseph, Mich.
Carbon & sulphur determinators

Laboratory for Electronics, Inc., 11 Lean St., Boston 15, Mass.
Computers, electrical and electronic instruments

Laboratory Furniture Co., Inc., Old Country Road, Mineola, L. I., N. Y.
Laboratory furniture

Laboratory Materials Co., 7319 Vincennes Ave. Chicago 21, Ill.
Laboratory supplies

Laboratory Specialties, Inc., 144 S. Wabash St., Wabash, Ind.
Mirrors—front surfaces & aluminized: Monochromatic light sources, Black light apparatus, Diffraction gratings, Spectroscopes, Fluorescent & phosphorescent materials

La Marche Mfg. Co., 6525 Olmstead Ave., Chicago 3, Ill.
Constant voltage regulators, rectifiers

**Lambda Electronics Corp., Corona, N. Y.**
Power supplies
**(See advertisement on page 106)**

Lammert & Mann Co. 260 N. Woods St., Chicago 12, Ill.
Flow regulators & valves

LaMotte Chemical Products Co., Towson, Md.
Hydrogen ion apparatus

Lampkin Laboratories, Inc., Bradenton, Fla.
Radio-frequency meters

Lancaster Lens Co., 220 N. Main St., Lancaster, Ohio
Optical components

Landis & Gyr, Inc., 45 West 45th St., New York 19, N. Y.
Electric integrating meters; indicating & graphic demand meters for KW, KVA, reactive; prepayment meters; totalizing & remote; time switches; motor wound escapement or synchronous motor types with astronomic dials; miniature ball bearings

Lansing Engineering Co., Electronics Div. 735 E. Kalamazoo St., Lansing, Mich.
Counters & timers

La Pine & Co., Arthur S., 121 W. Hubbard St., Chicago 10, Ill.
Laboratory supplies

Lapp Insulator Co., Inc., Le Roy, N. Y.
Automatic feeders and regulators, pumps, laboratory ware

Larrimore Sales Co., P. O. Box 1234, St. Louis 1, Mo
Magnifiers

**LAWTER...**
**Leader in Luminescence**

**PHOSPHORESCENT—FLUORESCENT PAINT SPECIALISTS**

•

**PIONEERS IN INSTRUMENT BLACK LIGHTING**

•

**Write for Technical Release 108 and Swatches**

**LAWTER CHEMICALS INC.**
**3563 Touhy Avenue**
**Chicago 45, Illinois**

Lavoie Laboratories, Matawan Freehold Rd., Morganville, N. J.
Ultra high frequency precision frequency meter

Lawrence & Hill, Inc., 142 Main Ave., Watertown, N. Y.
Gages & gaging fixtures

**Lawter Chemicals Inc., 3563 Touhy Ave., Chicago 45, Ill.**
Luminous and fluorescent chemicals and coatings
**(See advertisement on page 169)**

Leach Relay Co., 5915 Avalon Blvd., Los Angeles 3, Calif.
Relays

Lear, Inc., 110 Ionia Ave., N. W. Grand Rapids 2, Mich.
Electronic & mechanical aircraft accessories; aircraft radio equipment, radio compasses, etc.

Lectrohm, Inc., 5939 S. Archer Ave., Chicago 38, Ill.
Resistors

Ledeen Mfg. Co., 1600 S. San Pedro St., Los Angeles 15, Calif.
Automatic control valves

Leeds & Northrup Co., 4970 Stenton Ave. Philadelphia 44, Pa.
Electrical measuring instruments for both laboratory & plant. For laboratory: bridges, galvanometers, potentiometers, photometric equipment, test sets & standards. For plant: indicators, recorders & controllers for chemical concentration, $CO_2$, current, electrolytic conductivity frequency, gas analysis, humidity, Kw, Rkva, light, electrical load, pH, pressure, pyrometry, radiation, smoke density, speed temperature, voltage, Speedomax Recorders, Centrimax Flowmeters & Metermax Combustion control Systems

Leitz Inc., E.. 304 Hudson St., New York 13, N. Y.
Optical instruments

Leland Inc., G. H., 123 Webster Ave., Dayton 2, Ohio
Circuit selector switches, stepping relays, solenoids

Lenkurt Electric Co., 1118 County Road, San Carlos, Calif.
Ultrasonic-frequency transformers, metallic dust cored: inductors, electric wave filters

Lenox Instrument Co., 2010 Chancellor St., Philadelphia 3 Pa.
Optical and technical instruments

**Leslie Co., Grant Ave. and Val Brook Ave., Lyndhurst, N. J.**
Pressure reducing valves, pump governors, temperature regulators
**(See advertisement on page 147)**

Leupold & Stevens Instruments, 4445 N. E. Glisan St. Portland 13, Ore.
Recorders & indicators, for irrigation, power, waterworks, sewerage. Equipment for hydraulic laboatories. Snow-rain recorders, hydrographic accessories, transits, levels

Levin & Son, Louis, 782 E. Pico Blvd., Los Angeles, Calif.
Instrument lathes

Lewis & Co., J. B., 3324 Main St. Hartford 5, Conn.
Motor controls, adjustable speed-electronic exciters

Lewis & Kaufman, Inc., Los Gatos, Calif.
Electron tubes

**Lewis Engineering Co., 52 Rubber Ave., Naugatuck, Conn.**
Portable pyrometers, potentiometers, resistance thermometrs & other electrical tmperature measuring devices
**(See advertisement on outside back cover)**

Lewyt Corp., 60 Broadway, Brooklyn 11, N. Y.
Instrument housings

**Librascope Inc., 1607 Flower St., Glendale 1, Calif.**
Mechanical and electrical computers and analyzers, magnetic instruments
**(See advertisement on page 58)**

Lindberg Engineering Co., 2450 W. Hubbard St., Chicago 12, Ill.
Laboratory furnaces and controls

Linde Air Products Co., 30 E. 42nd St. New York 17, N. Y.
Gas gages, gas flowmeters, oxygen regulators

Lindly & Co., 8 Herrick Rd., Mineola, L. I., N. Y.
Optical components, illuminators

Link Aviation Devices, Inc., Binghamton, N. Y.
Aircraft navigational instruments

Link Engineering & Mfg. Co., 13845 Elmira St., Detroit 27, Mich.
Spring testers

Lion Mfg., Inc., 106 N. Grant Ave., Columbus, O.
Balancing machines, vibration pickups

Liquidometer Corp., 36-16 Skillman Ave., Long Island City 1, N. Y.
Liquid level gages

Liquid Scale Gauge Co., 100 N. First St., Minneapolis 1, Minn.
Liquid level indicating gages

Liquidepth Indicators, Inc., 43-22 10 St., Long Island City 1, N. Y.
Level gages

Liston-Folb Instrument Co., Inc., 20 Beckley Ave., Stamford, Conn.
Gas analyzers, amplifiers

Little, Inc., Arthur D., Memorial Drive, Cambridge 42, Mass.
Chemical feeds and special equipment

Logan Engineering Co., 4901 W. Lawrence Ave., Chicago 30, Ill.
Compressed air and gas separators

**Littelfuse Inc., 4757 N. Ravenswood Ave., Chicago 40, Ill.**
Low amperage precision fuses & fuse mountings
**(See advertisement on page 86)**

Lonergan Co., J. E., 213 Race St., Philadelphia, Pa.
Pressure gages

Lord Mfg. Co., 1635 W. 12 St., Erie, Pa.
Bonded rubber vibration isolation mountings & flexible couplings for practical horsepower motors

Lovins Engineering Co., 8203 Cedar St., Silver Springs, Md.
Scientific instruments and apparatus

L & R Manufacturing Co., 577 Elm St., Arlington N. J.
Instrument cleaning machines & cleaning & rinsing solutions. Crystal cement

Loudon Instruments, Inc., 5644 S. Lake Park Ave., Chicago 37, Ill.
Nuclear instruments, bridges and potentiometers, temperature instruments

Lufkin Rule Co., 1730 Hess Ave., Saginaw, Mich.
Precision tools & measuring tapes

Lumenite Electronic Co., 407 S. Dearborn St. Chicago 5, Ill.
Photoelectric controls

**Photo-Metal-Art**

**SCALES, RETICLES, CIRCUITRY, VIEWING SCREENS**

- **dimensional accuracy**
- **durability**
- **intricate patterns**
- **your blanks or we supply complete assemblies**

**Wm. I. Mann Co.**
**PRECISION OPTICS**
**1015 MISSION ST.**
**SOUTH PASADENA**
**CALIF.**

Lux Clock Mfg. Co., 95 Johnson St., Waterbury 91, Conn.
Automatic timers & clock mechanisms

Lyman Electronic Corp., 12 Cass St., Springfield Mass.
Radio test instruments

## M

Macalaster Bicknell Co., 234 Broadway, Cambridge 39, Mass.
Laboratory glass apparatus

Macbeth Corp., P. O. Box 950, Newburgh, N. Y.
Hydrogen ion meters

Macbeth Daylighting Corp., 227 West 17 St., New York 11, N. Y.
Daylight lamps for titration & color matching

Machlett Laboratories, Inc., Springdale Conn.
Vacuum tubes

Machlett & Son, E., 220 East 23rd St., New York 10, N. Y.
Laboratory apparatus & supplies

**MacDonald Co., Inc., W. S. 33 University Road, Cambridge 38, Mass.**
Microammeters, bolometers and magnetometers
**(See advertisement on page 63)**

MacLeod & Hanopol, Chelsea & Joiner St., Charlestown 29, Mass.
Radio testing instruments

Madison Electrical Products, Div., John G. Ruckelshaus Co., Madison, N. J.
Chokes, resistances

Magnaflux Corp., 5900 Northwest Highway Chicago 31, Ill.
Magnetic inspection equipment

Magnatrol Valve Corp., 67 Fifth Ave., Hawthorne, N. J.
Control valves

Magnavox Co., Inc., 2131 Bueter Rd., Fort Wayne 4, Indiana
Electrolytic capacitors

**Oregon Electronic Mfg. Co., 206 S.W. Washington St., Portland 4, Oregon**
**Regulated power supplies**

Orton Ceramic Foundation, Edward, Jr., 1445 Summit St., Columbus 1, Ohio
Pyrometric cones

Oster Mfg. Co. John, Terminal Bldg., 1 Main St., Racine, Wis.
Fractional horsepower motors

# P

Pacific Div., see Bendix Aviation Corp.

Pacific Optical Corp., 6145 West Century Blvd., Los Angeles 45, Calif.
Glass and plastic lenses

Pacific Scientific Co., Inc., 1430 Grande Vista Ave., Los Angeles 23, Calif.
Cable tension indicator

**Pacific Universal Products Co., 168 N. Vista Ave., Pasadena 8, Calif.**
Lenses and mirrors
**(See advertisement on page 98)**

**Palmer Thermometers, Inc., 2511 Norwood Ave., Cincinnati, Norwood 12, Ohio**
Industrial indicating "Red-Reading-mercury" thermometers, dial thermometers, recording thermometers
**(See advertisement on page 21)**

Palo-Myers Inc., 81 Reade St., New York 7, N. Y.
Laboratory supplies & boiler water testing equipment

Palos Optical Co., Box 6, Palos Hts., Ill.
Astronomical instruments, filters, optical flats, lenses, microscopes

Panellit, Inc., 7212 N. Clark St., Chicago 26, Ill.
Instrument panels, pressure indicators

Panoramic Radio Corp., 10 S. Second Ave., Mt. Vernon, N. Y.
Electronic instruments and inspection devices

Paragon Electric Co., Two Rivers, Wis.
Timers

Park Sales Co., 421 Canal St. New York 13, N. Y.
Micrometers and calipers

Parker Appliance Co., 17325 Euclid Ave., Cleveland 12, Ohio
Pressure snubbers, valves, fittings for instrument tubing

Parks Co., Harry S., 101 North 33 St., Philadelphia, Pa.
Gages pressure instruments

Parr Instrument Co., 211-53 St., Moline, Ill.
Combustion bombs, calorimeters, hydrogenation apparatus, melting point apparatus

Partlow Corp., 2 Campion Rd., New Hartford, N. Y.
Temperature indicators & controllers, time delay relays

**Passaic Analytical Laboratories, Inc., 228 Ayerigg Ave., Passaic, N. J.**
Instrument cleaning machines
**(See advertisement on page 86)**

Pastor Stop Watch Co., 43 East Main St., Waterbury 22, Conn.
Stop watches

Patent Button Co., Patwin Instruments Div., Waterbury 20, Conn.
Chemical analyzers, polarographic analyzers, flame photometers, indicating potentiometers

Patterson Screen Div., E. I. duPont de Nemours & Co., Towanda, Pa.
X-ray intensifying and fluorscopic screens

**Paul Valve Co., 683 Third Ave., New York 17 N. Y.**

Paulstick & Sons, H. 2124 Fulton St., Brooklyn 33, N. Y
Thermometers

Pelouze Mfg. Co., 1228 Chicago Ave., Evanston, Ill.
Torque gages

Penberthy Instrument Co., 666 Adams St., Seattle 8, Wash.
Industrial and smoke periscopes

Penn Industrial Instrument Corp., 4110 Haverford Ave., Philadelphia 32, Pa.
Flow meters

Penn Optical & Inst. Co., 50 S. San Gabriel Blvd., Pasadena 8, Calif.
Optical parts

Perfex Corp., 500 W. Oklahoma Ave., Milwaukee 7, Wis.
Automatic temperature controls for oil burners, stokers, gas burners, refrigeration & air conditioning

Perkin-Elmer Corp., P. O. Box 730, Norwalk, Conn.
Optical instruments

**Perkins & Son, Inc., B. F., Mullen Tester Div., P. O. Box 388, Holyoke, Mass.**
Testers for leather, paper & textiles
**(See advertisement on page 130)**

**Permo Incorporated, 6415 Ravenswood Ave. Chicago 26, Ill.**
Instrument pivots & Contacts
**(See advertisement on page 154)**

Permutit Company, 330 West 42nd St., New York 18, N. Y.
Indicators & recorders for $CO_2$, specific gravity of natural manufactured or process gases, exhaust gas analysis, other uses where gas density guides operation

Petrometer Corp., 1 Star Square, Long Island City 1 N. Y.
Distant reading, liquid level tank gages

Pfaltz & Bauer, Inc., 350 5th Ave., New York 1, N. Y.
Laboratory control instruments

Phen-Trols, Inc., 15 Franklin Place, Rutherford, N. J.
Pyrometers, thermocouples, instrument and regulating transformers

Philadelphia Gear Works, Inc., G St. and Erie Ave., Philadelphia Pa.
Control valves

**Philadelphia Thermometer Co., 6th and Sayuga Sts., Philadelphia 40, Pa.**
Instruments for temperature indication, control & regulation
**(See advertisement on page 137)**

**Philamon Labs., 5717 Third Ave., Brooklyn 20, N. Y.**
Tuning forks
**(See advertisement on page 145)**

**Philbrick Researches. Inc., George A., 230 Congress St., Boston 10, Mass.**
Computors and analogs
**(Ste advertisement on page 54)**

Philips Manufacturing Co., 3475 W. Touhy Ave., Chicago, Ill.
Vapor degreasers & instrument cleaning machines

Phillips Control Corp., 84 W. Jefferson St., Joliet, Ill.
Relays and solenoids

Phillips Petroleum Co., Bartlesville, Okla.
Automatic analyzers, chemical composition recorders, laboratory apparatus

Phipps and Bird, Inc., 303 S. Sixth St., Richmond 5, Va.
Laboratory apparatus & chemicals

Phoenix Precision Instrument Co., 3803 N. 5th St. Philadelphia 40, Pa.
Laboratory equipment

Photocon Research Products, 1061 N. Allen Ave., Pasadena 7, Calif.
Precision mechanical instruments

Photographic Products Inc., 6916 Romaine St., Hollywood 38, Calif.
Recording and oscilloscope cameras

Photo Research Corp., 15024 Devonshire St., San Fernando, Calif.
Optical instruments and testers

**Photron Instrument Co., 6516 Detroit Ave., Cleveland 2, Ohio**
Photoelectric colorimeters
**(See advertisement on page 101)**

Photoswitch, Inc., 77 Broadway, Cambridge, Mass.
Industrial photoelectric controls including counting equipment, electronic timers & special electronic controls, smoke controls

Photovolt Corp., 95 Madison Ave., New York 16, N. Y.
Photo-electric elements, photometers electronic timing devices, photo-electric colorimeters, photo-electric exposure meters, densitometers

Physicists Research Co., 321 S. Main St., Ann Arbor, Mich.
Specialists in solution of unusual industrial research jobs, with special experience in machinery noise reduction, development of special instrumnts, & measurement of surface irregularities

Picker X-Ray Corp. 300 Fourth Ave., New York 10, N. Y.
X-ray equipment

Pickering Governor Co., Pickering St., Portland, Conn.
Governors

Pierce Watch Company, 22 West 48th St., New York 19, N. Y.
Stop watches

Pike & Co., E. W., Elizabeth B, N. J.
Illuminated magnifiers & microscopes

Pipe Machinery Co., 930 E. 70th St. Cleveland, Ohio
Inspection gages

Pitometer Log Corp., 237 Lafayette St., New York 12, N. Y.
Pilot tube flowmeters

**Pittsburgh Instrument & Machine Co., 1026 Reedsdale St., Pittsburgh 12, Pa.**
Brinell Machines, alternating impact machines, surveying instruments
**(See advertisement on page 132)**

Pittsburgh Lectrodryer Corp., P. O. Box 1766, Pittsburgh, Pa.
Instrument air dryers

Plastic Service Guild, 233 Condor St., East Boston 28, Mass.
Chemically resistant plastic coatings for metal

Plummer & Kershaw, 2757 Frankford Ave., Philadelphia 34, Pa.
Optical parts

Pneumercator Co., Inc., 305 E. 46 St., New York 17, N. Y.
Level indicators

Podbielniak, Inc., 341 East Ohio St., Chicago 11, Ill.
Scientific and industrial laboratory apparatus

Polarad Electronics Co., 100 Metropolitan Ave., Brooklyn 11, N. Y.
Amplifiers, audiofrequency equipment, oscilators, remote control equipment

Polarized Light-Photoelastic Co., 96 Tompkins Circle, Staten Island 1, N. Y.
Photoelastic polariscopes

Polarizing Instrument Co., Mount Kisco, N. Y.
Photoelasticity apparatus

Polytechnic Research & Development Co., Inc., 202 Tillary St., Brooklyn 1, N. Y.
Electronic instruments, regulated power supplies

Poole Instruments Inc., 1816 Magnolia St., Dallas 1, Texas
Tube inside micrometer for big gun internal measurements and refinery still tubes

Porter, Inc., George K., Box 216, Hatboro, Pa.
Glass blowing, precision cylindrical and tapered tubing

Post Company, Frederick, P. O. Box 803, Chicago 90, Ill.
Instruments & equipment for architect & engineer

Post Machinery Co., 140 Elliotte St., Beverly, Mass.
High speed electronic counter

**Potter & Brunfield Mfg. Co., Princeton, Ind.**
Relays
**(See advertisement on page 119)**

**Potter Aeronautical Co., 89 Academy St., Newark 2, N. J.**
**(See advertisement on page 70)**

Potter Co., 1950 Sheridan Rd., North Chicago, Ill.
Capacitors

Potter Instrument Co., 115 Cutter Mill Road, Great Neck, L.I., N. Y.
Photoelectric counters and controls

**Powers Regulator Co., 3400 Oakton St., Skokie, Ill.**
Controls for air conditioning temperature & humidity; also water temperature controls, dial indicating & recording thermometers & steam traps
**(See advertisements on pages 59, 136, 151)**

Pratt & Whitney. Div. Niles-Bement Pond Co., West Hartford, Conn.
Machine shop instruments

**Precise Co., 942 Kings Highway, Brooklyn 23, N. Y.**
Optical and electrical instruments, fluorescent chemicals and tubes, ultraviolet light sources
**(See advertisement on page 84)**

Precision Apparatus Co., Inc., 92-27 Horace Harding Blvd., Elmhurst, L. I. N. Y.
Radio test instruments

Precision Gage & Tool Co., 320 East 3d St., Dayton 2, Ohio
Machine shop gages

Precision Products, Inc., 516 South Lansing St., Tulsa 5, Okla.
Time switches

Precision Radiation Instruments, Inc., 4113 W. Jefferson St., Los Angeles 16, Calif.
Alpha, beta and gamma counters

Precision Resistor Co., 334 Badger Ave., Newark 8, N. J.
Resistors

Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.
Standard & custom-built laboratory equipment

Precision Thermometer & Instrument Co., 1434 Brandywine St., Philadelphia 30, Pa.
Scientific instruments

**Precision Tube Company, 3824-26-28 Terrace St., Philadelphia, Pa.**
Fine tubing & metal shielded wire
**(See advertisement on page 146)**

Preferred Utilities Mfg. Corp., 1860 Broadway, New York, N. Y.
Boiler plant instruments

**Preis Engraving Machine Co., H. P., 651 State Highway 29, Hillside, N. J.**
Engraving, etching, marking and printing machines, tools and supplies
**(See advertisement on page 68)**

Premier Crystal Labratories, Inc., 79 Seventh Ave. New York 11, N. Y.
Piezo electric quartz and tourmaline crystals, reactance & capacity meters

Presto Recording Corp., Paramus, N. J.
Magnetic tape recorder

Price Electric Corp., Frederick, Md.
Relays

**Pritchard & Co., J. F., 908 Grand Ave., Kansas City, Mo.**
Instrument air dryers
**(See advertisement on page 43)**

Process Controls Co., 2 East End Ave., New York 21, N. Y.
Designers and builders of electrical, mechanical and electronic controls for automatic equipment and processes

Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
Scientific Instruments

Production Instrument Co., 710 W. Jackson Blvd., Chicago 6, Ill.
Electric & mechanical counting, timing & recording devices & actuating switches

Proportioneers, Inc., 345 Harris Ave., Providence, R..I
Automatic controlling & proportioning equipment

Pyle National Co., 1334 N. Kostner Ave. Chicago 51, Ill.
Connectors

Pyramid Instrument Corp., 49 Howard St., New York 13, N. Y.
Electrical instruments, pyrometers

**Pyrometer Instrument Co., Inc., Bergenfield 4, N. J.**
Pyrometers for various purposes
**(See advertisement on page 109)**

Pyrometer Service Co., 228 River Rd., Arlington, N. J.
Pyrometer tubes, thermocouples

## R

Racine & Co., Jules, 20 West 47th St., New York 19, N. Y.
Stop watches

Radex Corp., 2076 Elston Ave., Chicago 14, Ill.
Electrical testers

Radiation Counter Labs., 1844 W. 21 St., Chicago 8, Ill.
Geiger-Muller counters, radium detectors

Radioactive Products, Inc., 443 W. Congress St., Detroit 26, Mich.
Radiation survey instruments, electrical and testing instruments

Radio City Products, Inc., 152 W. 25th St., New York 7, N. Y.
Electrical & radio testing instruments & accessories

Radio Frequency Laboratories Inc., Boonton, N. J.
Electronic equipment

Radio Receptor Co., Inc., 84 N. 9th St., Brooklyn 11, N. Y.
Radio test instruments, remote control systems

**Rahm Instruments, Inc., 12 W. Broadway, New York 7, N. Y.**
Electroenciphalographs; oscillographs
**(See advertisement on page 143)**

Ranco, Inc., 601 West Fifth Ave., Columbus 1, Ohio
Refrigeration controls

Rapidesign, Inc., 111-BS Orange St., Glendale, Calif.

Rascher & Betzold, Inc., 730 N. Franklin St., Chicago 10, Ill.
Laboratory supplies

Rauland Corp., 4245 N. Knox Ave., Chicago 41, Ill.
Cathode ray tubes

Rattray & Co., Inc., George, 92-32 Union Hall St., Jamaica 5, N. Y.
Voltage-dividing resistors

Rauland-Borg Corp., 3523 W. Addison St., Chicago 18 Ill.
Amplifiers, audio-frequency equipment, microphones

**Rawson Electrical Instrument Co., 112 Potter St., Cambridge, Mass.**
Dynamometers, wattmeters, milliameters & voltmeters. Also ultra-sensitive meters both for A.C. & D.C., fluxmters, electrostatic voltmeters, Thermocouples in vacuum earth current meters, cable testers, millisecond timers
**(See advertisement on page 152)**

Raytheon Mfg. Co., 190 Willow St., Waltham 54, Mass.
Automatic & manually controlled rectifiers for all communication, industrial or laboratory applications

RCA Division, Radio Corporation of America, Camden, N. J.
Radio & electronic equipment for all purposes including laboratory & industrial apparatus

R. C. Scientific Instrument Co., 335 Culver Blvd., Playa del Ray, Calif.
Radiation counters

Redington Co. F. B., 112 S. Sangamon St., Chicago 7, Ill.
Counters: production, revolution, stroke

Redmond Co., Inc., Owasso, Mich.
Fractional horsepower motors

Reed Research, Inc., 1048 Potomic Ave. N.W., Washington 7, D. C.
Computers, oscillographs, analyzers

Reeder & Co., Charles M., 171 Victor Ave., Detroit 3, Mich.

Reeves Hoffman Corp., 321 Cherry St., Carlisle, Pa
Piezoelectric and quartz crystals

Reeves Instrument Corp. 215 E. 91 St., New York, N. Y.
Computers

Refinery Supply Co., 621 East Fourth St., Tulsa 3, Okla.
Gas testing instruments & specialties for oil & gas industry; & laboratory supplies

Refrigeration Systems, Inc., 646 W. Washington Blvd., Chicago 6, Ill.
Temperature and humidity cabinets, cloud-and-pour oil testers

Reiner Electronics Co., 152 W. 25th St., New York 1, N. Y.
Electronic testing equipment

Reliance Gauge Column Co., 5902 Carnegie Ave. Cleveland 3, Ohio
Steam specialties

Reliance Instrument Co., 3938 W. Roosevelt Road, Chicago 24, Ill.
Electrical indicating instruments

**Republic Flow Meters Co., 2240 Diversey Parkway, Chicago 47, Ill.**
Remote reading flow meters, complete line of power plant & industrial instruments for the measurement of flow, level pressure, draft, temperature & $CO_2$. Automatic boiler controls, regulators, valves and desuperheaters
**(See advertisements on pages 55, 74, 92, 115, 142, 149)**

Research Control Instrument Co., 8211 E. 7 St., Tulsa, Okla.
Automatic and manual controllers, valves, components

Resistance Products Co., 714 Race St., Harrisburg, Pa.
Resistors

Resistors, Inc., 5226 West 26 St., Chicago 50, Ill.
Resistors adjustable, variable & wire wound

Revere Corporation of America, P. O. Box 304, Walingford, Conn.
Thermocouples for liquids, air, metal, hot gases, thermocouple wire, hardnesses and leads. Pitot tubes (shielded and unshielded). Engine & Flight test recording accessories

**Rex Rheostat Co., 3 Foxhurst Rd., Baldwin L.I., N.Y.**
Protected and unprotected slide-contact rheostats & adjustable, wire wound resistors
**(See advertisement on page 120)**

Reynolds Gas Regulator Co., Anderson, Ind.
Automatic valves & regulators

Rhoades Metaline Co., Inc., R. W., 50-17 Fifth St., Long Island City 1, N. Y.
Rubber stoppers

Rhodes, Inc., M. H., 30 Bartholomew Ave., Hartford 6, Conn.
Time switches

**Richards Co., Inc., Arklay S., 52 Winchester St., Newton Highlands 61, Mass.**
Thermocouples, lead wire & protection tubes
**(See advertisement on page 134)**

Richardson-Allen Corp., 116-15 Fifteenth Ave., College Point, L. I., N. Y.
Timers and time switches

Richardson Scale Co., Clifton, N. J.
Automatic weighing machinery

Riehle Testing Machine Division, American Machine & Metals Inc., East Moline, Ill.
Testing machines & testing instruments for tension, compression, bending, torsion, shear, hardness, wear

Rieker Instrument Co., 1919 Fairmount Ave., Philadelphia 30 Pa.
Scientific instruments

Rimat Machine Tool Co., 1117 Air Way, Glendale 1, Calif.
Micrometers

Ritchie & Son, E. S., 112 Cypress St., Brookline 46, Mass.
Marine instruments

Riverbank Laboratories, Geneva, Ill.
Tuning forks

R & M Mfg. Co., Royal Oak Mich.
Machine shop gages

Robbins & Myers, Inc., 1345 Lagonda Ave., Springfield 99, Ohio

Robertson & Co., John H., 4153 W. Belmont Ave., Chicago 41, Ill.
Scientific glassware, laboratory apparatus

Robinette Co., W. C., 802 Fair Oaks Ave., S. Pasadena, Calif.
Automatic control devices

Robinson Orifice Fitting Co., 2830 Lugo St., Los Angeles 23, Calif.
Orifice fittings & plates

**Rochester Mfg. Co., Inc., 100 Rockwood St., Rochester 10, N. Y.**
Pressure & liquid level indicators & thermometers
**(See advertisement on page 135)**

Rockwell Co., Stanley P., 296 Homestead Ave., Hartford 5, Conn.
Dilatometers

**Rockwell Co., W. S., 264 Eliot St., Fairfield, Conn.**
Butterfly control valves
**(See advertisement on page 146)**

Rockwell Engineering Co., 4063 N. New Jersey St., Indianapolis 5, Ind.
Special instruments

**Rockwell Mfg. Co., 400 Lexington Ave., Pittsburgh, Pa.**
Fluid meters
**(See advertisement on page 35)**

Roemer Drug Co., 606 N. Broadway, Milwaukee 2, Wis.
Laboratory supply house

**Roller-Smith Corp., 1000 Eighth Ave., Bethlehem, Pa.**
Instruments (indicating & graphic) air & oil circuit breakers, relays, switchboards, precision balances, transformers, instrument & control switches
**(See advertisement on page 48)**

Rollin Co., 2070 N. Fair Oaks Ave., Pasadena 3, Calif.
Electronic test equipment

Rosen Engineering Products, Inc. Raymond, 32nd & Walnut Sts., Philadelphia 4, Pa.
Telemetering

Rotron Div., Jenkes Knitting Machine Co., 180 Weeden St., Pawtucket, R. I.
Air-operated switches

R-S Products Corp., 4523 Germantown Ave., Philadelphia 44, Pa.
Butterfly valves & heat treating furnaces

Rubicon Co., Ridge Ave. at 35th St., Philadelphia 32, Pa.
Precision electrical instruments: potentiometers, galvanometers, bridges resistance standards, for standardization, research, calibration of meters, production testing, & educational applacitions. Photoelectric colorimeters, transmission dynamometers & other special apparatus

Rudolph & Sons, O. C., P. O. Box 446, Caldwell, N. J.
Optical instruments

Ruehfel Co., Inc., George, 107-20 101 Ave., Richmond Hill, L. I., N. Y.
Laboratory instruments & apparatus

Rupp & Bowman Co., 315 Superior St., Toledo 3, Ohio
Laboratory supplies

WANTED

DEFENSE CONTRACTS

for

- SCREW MACHINE PRODUCTS
- STAMPINGS
- ASSEMBLIES

PRECISION MADE IN ANY QUANTITY

put STEINEN experience to work for you . . .

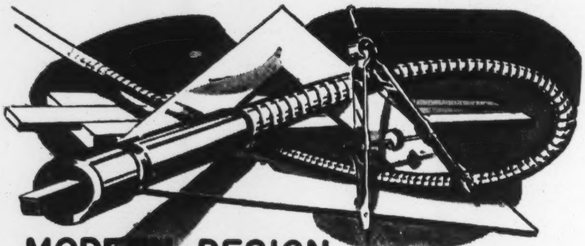
Let Steinen engineering "know-how" and the experience of over 40 years in serving outstanding American manufacturers help you now.

Steinen offers its extensive facilities—modern, high speed machine tools, production methods and technical skill in making and assembling screw machine products and stampings in all metals. We produced many important quality items in enormous quantities for the last war. We are better equipped than ever in meeting defense contracts.

We invite your inquiries—whether for a hundred, a thousand or a million units.

WM. STEINEN MFG. CO.

45 Bruen St. Newark 5, N. J.



MODERN DESIGN AND ENGINEERING

Many an industry owes much of the success of its products to the modern solution of its angular drive problems with flexible shafting. The right application of a flexible shaft can mean greater flexibility in alignment . . . better integration of units . . . less complex gearing.

The result is lower assembly costs and a product that is quiet, smooth, efficient and trouble-free in operation with minimum repair requirements. Circle Ess flexible shafts will stand the most rigid tests and scrutiny. They will help to solve your problems as they have those of many other manufacturers.

*Write for our new book "Flexible Shaft Assemblies"*

CIRCLE ESS

F. W. STEWART MFG. CORPORATION

4311-13 RAVENSWOOD AVE. CHICAGO 13, ILL.

WEST COAST BRANCH: 431 VENICE BLVD., LOS ANGELES 15, CAL.

Ruska Instrument Corp., 4607 Montrose Blvd., Houston 6, Texas
Geophysical instruments

Rutherford Electronics Co., 3707 S. Robertson Blvd., Culver City, Calif.
Calibrating equipment for electrical and electronic instruments, radar simulators

Rutherford Instrument Co., P. O. Box 7406, Washington 4, D. C.
Polygraph

Rutishauser Corp., 490 S. Fair Oaks Ave., Pasadena 2, Calif.
Military and research instruments, engine indicators, oscilloscope cameras

Ruttco Mfg. Co., 105-20 Metropolitan Ave., Forest Hills N. Y.

Ryan Tool & Engineering Co., 19159 John R. St., Detroit 3, Mich.
Height gages, fixtures, special machinery.

## S

Saart, Kraemer & Hanscom, Inc., 1 Washington Park, Providence 5, R.I.
Machine shop gages

Sampsel Time Control, Inc., Spring Valley, Ill.
Combustion control equipment

**Sampson Chemical & Pigment Corp., 2830 W. Lake St., Chicago 12, Ill.**
Phosphorescent and fluorescent coatings
**(See advertisement on page 38)**

**Sanborn Co., 39 Osborne St., Cambridge, Mass.**
Electronic instruments
**(See advertisement on page 112)**

Sangamo Electric Company, 1022 Converge Ave., Springfield, Ill.
Electric meters of all types; also instrument transformers, time switches & radio condensers

Sarco Company, Inc., 350 Fifth Ave., New York 1, N. Y.
Temperature regulators

Sargent & Co., 4647 Foster Ave., Chicago 30, Ill.
Laboratory supplies & chemicals

Saxl Instrument Co., Harvard, Mass.
Tension and torque measuring instruments

Schaar & Co., 754 W. Lexington St., Chicago 7, Ill.
Laboratory supplies

Schade Valve Mfg. Co., 2527 N. Bodine St., Philadelphia 33 Pa.
Automatic valves

Schaefer Bros., Co., 1059 W. 11th St., Chicago 7 Ill.
Rheostats

Schaevitz Engr., Crescent Blvd. at Drexel Ave., Camden, N. J.
Accelerometers, extensometers position indicators, remote metering equipment

Schaffer Poidometer Co., 2828 Smallman St., Pittsburgh 22, Pa.
Scales

Schauer Mfg. Co., 2060 Reading Rd., Cincinnati 2, Ohio
Battery chargers, battery eliminators and rectifiers

Scherr Co., Inc., George 200 Lafayette St., New York 12, N. Y.
Optical measuring and inspection equipment

**Schneider-Cogswell, Inc., 1849 Halstead St., Chicago 14, Ill.**
Precision lenses and prisms
**(See advertisement on page 98)**

Schultheis Corp., E.W., 812-814 Wyckoff Ave., Brooklyn 27, N. Y.
Thermometers and hydrometers

Schutte & Koerting Co., Cornwells Heights, Bucks County, Pa.
Rotameters

Schwien Engineering Co., 5736 W. Washington Blvd. Los Angeles, Calif.
Aircraft instruments & pressure control instruments

S & C Electric Co., 4435 Ravenswood Ave., Chicago 40, Ill.
High voltage testers, voltage detectors

Scientific Apparatus Co., 4 Landscape Ave., Yonkers 5. N Y.
Laboratory apparatus

Scientific Equipment Co., 11801 W. Olympic Blvd., Los Angeles, Calif.
Flame photometer

Scientific Glass Apparatus Co., Inc., 100 Lakewood Ave., Bloomfield, N. J.
Glass apparatus & interchangeable ground glass joints

Scientific Instrument Co., 1041 Second St., Detroit 26, Mich.
Industrial & laboratory thermometers; hydrometers; special laboratory apparatus

Scientific Supplies Co., 12 Jackson St., Seattle 4, Wash.

Scott, Inc., Hermon Hosmer, 385 Putnam Ave., Cambridge, Mass.
Electronic instruments

Scott Testers, Inc., 101 Blackstone St., Providence, R. I.
Testing machines

**Seedburo Equipment Co., 618 W. Jackson Blvd., Chicago 6, Ill.**
Moisture-testers, ovens, scales, thermometers
**(See advertisement on page 93)**

Seederer-Kohlbusch, Inc., 27-29 S. Van Brunt St., Englewood, N. J.
Analytical balances & weights

Seely Instrument Co. Inc., 377 4th St., Nigara Falls, N. Y.
Controllers & valves

Sell Electric Co., H. H., 3240 Dakota Ave., Minneapolis 16, Minn.
Phase sequence indicators

Sendur Mfg. Co., 3225 N. Sheffield St., Chicago 13, Ill.
Electrical instruments

Sensitive Research Instrument Co., 9-11 Elm Ave., Mt. Vernon, N. Y.
Electrical instruments measuring quantities or values of small current or voltage

Serdex, Inc., 91 Cambridge St., Boston 14, Mass.
Meteorological instruments

**Service Recorder Co., 1375 Euclid Ave., Cleveland, Ohio**
Vehicle recorders
**(See advertisement on page 139)**

Servo Corp. of America, 2020 Jericho Tpke., New Hyde Park, N. Y.
Servomechanisms, computers, automatic control equipment and aircraft instruments

Servomechanisms Inc., Post & Stewart Ave., Westbury, N. Y.
Computers, amplifiers, servomotors

Servo-Tek Products Co. Inc., 4 Godwin Ave., Paterson, N. J.
Motion, position and speed recorders

Seth Thomas Clock Co., see Thomas, Seth

Shallcross Controls, Inc., 2217 N. 31 St., Milwaukee 8, Wis.
Furnace controls

Shallcross Manufacturing Co., 10 Jackson Ave., Collingdale, Penna.
Rotary Selector Sitches with solid silver contacts, accurate instrument resistors 0.1% — 5%, decade resistances & standards, bridges, telephone transmission test sets, resistance thermometers, bonding testers & special instruments for electrical measurements

Shand & Jurs Co., 917 Carlton St., Berkeley, Calif.
Liquid level gages

Shawmut Engg. Co., 195 Freeport St., Boston 22, Mass.
Abrasion testers

Sheffield Corp., Box 893, Dayton 1, Ohio
Machine shop gages

Shelby Instrument Co., 321 West 7 St., Long Beach 2, Calif.
Electrical instruments

Sheldon & Co., E. H., Muskegon, Mich.
Laboratory furniture

Shepard Labs., 430 Morris Ave., Summit, N. J.
Automatic exposure controllers, relays, ordnance instruments

Sherron Metallic Corp., 1201 Flushing Ave., Brooklyn 6, N. Y.
Electrical testing equipment

**Shore Instrument & Mfg. Co., Van Wyck & Carll St., Jamaica 2, N. Y.**
Scleroscope hardness testers
**(See advertisement on page 131)**

**Shurite Meters, 61 Hamilton St., New Haven 8, Conn.**
Electrical panel & portable instruments
**(See advertisement on page 44)**

Sickles Co., F. W., Springfield 2, Mass.
Electrical products

Sigma Instruments Inc., 170 Pearl St., South Braintree, Mass.
Relays

Signal Electric Mfg. Co., Menominee, Mich.
Fractional horsepower motors

Signal Indicator Co., 894 Broadway, New York 3, N. Y.
Dial lights

Simplex Time Recorder Co., Sanborn St., Gardner, Mass.
Time recording clocks

Simplex Valve & Meter Co., 68th & Upland Sts., Philadelphia 42, Pa.
Flow controls, meters, gages, proportioning & ratio control equipment

**Simpson Electric Co., 5216 Kinzie St., Austin Station, Chicago 44, Ill.**
Electrical instruments
**(See advertisement on page 152)**

**Simpson Optical Mfg., 3200 W. Carroll Ave., Chicago 24, Ill**
Lenses, prisms, optical flats & complete optical systems
**(See advertisement on page 99)**

Sinclair Collins Valve Co. 454 Morgan Ave., Akron, Ohio
Automatic controllers and control valves

Size Control Company, 2500 Washington Blvd., Chicago 12, Ill.
Machine shop & special gages, measuring wires

Sjostrom Co., John E., 1711 N. Tenth St., Philadelphia 22, Pa.
Laboratory furniture

Skaneateles Manufacturing Co., Inc., 122 Dickerson St., Syracuse 2, N. Y.
Vacuum gages

Skyway Precision Tool Co., 3217 Casitas Ave., Los Angeles 26, Calif.
Torque testers

Slocomb Co., J. T., 35 Oxford St., Providence 5, R. I.
Micrometer calipers

Small Motors, Inc., 2076 Elston Ave., Chicago 14, Ill.
Universal fractional horsepower motors, dynamotors, shaded pole motors & generators

Smith Control & Instrument Corp., 1329 Highland Ave., Needham 92, Mass.
Thermostats

**Smith Corp., A. O., 5743 Smithway, Los Angeles 22, Calif.**
Gasoline and oil meters
**(See advertisement on page 79)**

Sodemann Heat & Power Co., 2300 Delmar Blvd., St. Louis 3, Mo.
Air conditioned moist cabinet

Sola Electric Co., 4633 W. 16th St., Chicago 50, Ill.
Transformers, automatic voltage adjusters

**Soreng Mfg. Corp., 9555 Eden Ave., Schiller Park, Ill.**
Solenoids and switches
**(See advertisement on page 123)**

Sorensen & Co., Inc., 375 Fairchild Ave., Stamford, Conn.
Chokes, current regulators, voltage regulators, transformers

Sorvall, Ivan, 210 5th Ave., New York 10, N. Y.
Variable transformers

Sound Apparatus Co., Sterling, N. J.
Sound measuring equipment

South Bend Lathe Works, 303 E. Madison St., South Bend, Ind.
Precision lathes

Southern Desk Co., Hickory, N. C.
Laboratory furniture

South Specialty Engineering, see Specialty Eng. & Mfg. Co.

Southwestern Industrial Electronic Co., 2831 Post Oak Road, Houston 19, Texas
Geophysical instruments, industrial controls, electronic development

Sparling, R. W., 945 N. Main St., Los Angeles 54, Calif.
Liquid meters

Special Instruments Lab. Inc., 1003 Highland Ave., Knoxville, Tenn.
Radioactivity and geophysical instruments

Specialized Instruments Corp., 601 O'Neil Ave., Belmont, Calif.
Ultra-speed centrifuges

Specialties Inc., Skunks Misery Rd., Syosset, L. I., N. Y.
Computers, airbourne instruments and cameras, air dehydrators

**Specialty Battery Co., 212 East Washington Ave., Madison 3, Wis.**
Dry batteries
**(See advertisement on page 49)**

Specialty Engineering and Mfg. Co., 108 E. Dedham St., Boston, Mass.
Specialists in precision engineering and light manufacturing

Specialty Glass Co., 536 Lake Shore Drive, Chicago 11, Ill.
Laboratory glassware

Speedometer Electric Co., 690 Van Ness Ave., San Francisco, Calif.
Survey footmeter

Speidel & Co., Inc., Chas. W., 614 Baltimore Ave., Fernwood, Pa.
Surveying instruments

Spence Engineering Co., Inc., 53 Grant St., Walden N. Y.
Regulating valves

Sperry Gyroscope Co., Inc., Great Neck, N. Y.
Aircraft & marine navigational instruments

Sperry Products, Inc., Shelter Rock Road, Danbury, Conn.
Special railway testers

Sperry-Sun Well Surveying Co., 1600 Walnut St., Philadelphia 3, Pa.
Underground surveying instruments for oil wells

Sprague Electric Co., Marshall St., North Adams, Mass.
Electrical instruments, resistors, capacitors and circuit components

Sprague Engineering & Sales, 1144 W. 135 St., Gardena, Calif.
High-pressure pumps

Sprague Meter Co., 35 South Ave., Bridgeport 4, Conn.
Liquid meters

Sprengnether Instrument Co., W. F., 4567 Swan Ave., St. Louis 10, Mo.
Scientific instruments magnetometers, seismographs

Squires Co., C. E., E. 40th St. & Kelly Ave., Cleveland 3, Ohio.
Feed water regulators & pump governors

Stafford Co., N., 113 53 St., Brooklyn, N. Y.
Nautical, naval & navigation instruments

Standard Arcturus Corp., 54 Clark St., Newark, N. J.
Vacuum tubes

**Standard Cabinet Co., 50 Washington St., Carlstadt, N. J.**
Test chambers: altitude, temperature, humidity
**(See advertisement on page 51)**

Standard Concrete Apparatus Co., 1422 Rhode Island Ave., Washington 5, D. C.
Concrete testing equipment

Standard Dayton Corp., P. O. Box 1001, Dayton 1, Ohio
Fractional horsepower motors

Standard Electrical Products Co, 402 E. First St., Dayton 2, Ohio
Relays

**Standard Electric Time Co., 89 Logan St., Springfield 2, Mass.**
Electric stop clocks, electric time systems, watt hour meter testing equipment, program clocks, laboratory jack panels & small laboratory table service panels
**(See advertisement on page 140)**

Standard Gage Co., Inc., 70 Parker Ave., Poughkeepsie, N. Y.
Gages for linear measurements

Standard Piezo Co., 127 Cedar St., Carlisle, Pa.
Piezoelectric and quartz crystals

Standard Products, Inc., 650 E. Gilbert St., Wichita 11, Kan.
Aircraft and ground-station instruments, testing apparatus, precision tools

Standard Science Supply Co., 1232 N. Paulina St., Chicago 22, Ill.
Laboratory supplies

Standard Scientific Supply Corp., 34 W. 4 St., New York 12, N. Y.
Laboratory supplies

Standard Thermometer, Inc., 952 Dorchester Ave., Boston, Mass.
Mechanical thermometers

Standard Transformer Corp., 3580 Elston Ave., Chicago 18, Ill.
Transformers

Star Compass Co., 110 Antwerp St., East Milton, Mass.
Compasses

Starrett Co., L. S., Athol, Mass.
Precision tools, dial indicators & steel tapes

States Co., 19, New Park Ave., Hartford 6, Conn.
Electricity meter testers

Statham Laboratories, 12401 W. Olympic Blvd., Los Angeles 64, Calif.
Acclerometers, dynamometers, strain gages, flow-meters, pressure indicators, tension indicators

Stebar Co., 711 W. Lake St., Minneapolis 8, Minn.
Microscopes

Steel City Testing Machines, Inc., 8843 Livernois Ave., Detroit 4, Mich.
Testing machines

**Steinen Mfg. Co., Wm., 45 Bruen St., Newark, N. J.**
Precision screw machine products, stampings and assemblies
**(See advertisement on page 174)**

Sterling Inc., 3738 North Holton, Milwaukee 12, Wisc.
Motor operated valves

Sterling Mfg. Co., 9205 Detroit Ave., Cleveland, Ohio
Battery testers and portable electrical instruments

**Stevens-Arnold Co., 22 Elkins St., So. Boston 27, Mass.**
Relays, frequency & polarized
**(See advertisement on page 53)**

Stevens Mfg. Co., Inc., 69 S. Walnut St., Mansfield, Ohio
Controllers, automatic thermostatic, thermostats

Stewart, M. C., Ashburnham, Mass.
Meteorological instruments

Stewart Instrument Co., 6507 Grand River Ave., Detroit 8, Mich.
Production analyzers

**Stewart Mfg. Corp., F. W., 4311 Ravenswood Ave., Chicago 13, Ill.**
Remote control equipment
**(See advertisement on page 174)**

Stewart-Warner Corp., 1826 Diversey Parkway, Chicago 14, Ill.
Tachometers and pressure gages

**Sticht Co., Inc., Herman H., 27 Park Pl., New York 7, N. Y.**
Electrical instruments
**(See advertisements on pages 126, 127)**

Stocker & Yale, P. O. Box 8, Marblehead, Mass.
Optical instruments

Stoelting, C. H., 424 N. Homan Ave., Chicago 24, Ill.
Laboratory supplies

Stokes Machine Company, F. J., 5820 Tabor Road, Philadelphia, Pa.
Special process machinery; pressure & vacuum gages; pellet presses; high vacuum pumps; McLeod vacuum gages; automatic water stills

**Streeter-Amet Company, 4101 Ravenswood, Chicago 13, Ill.**
Automatic measuring, weighing & counting machines
**(See advertisement on page 139)**

Stromberg Time Corp., 109 Lafayette St., New York 13, N. Y.
Timing devices & time clocks

Struthers-Dunn, Inc., 150 N. 13 St., Philadelphia 7, Pa.
Relays, timing devices, electric counters, thermostats

Stupakoff Ceramic & Mfg. Co., Latrobe, Pa.
Ceramic thermocouple insulators and protection tubes

Sturtevant Co., P. A., Addison, Ill.
Torque measuring equipment

Sub-Zero Products Div., Deepfreeze Distributing Corp., 3928 Reading Rd., Cincinnati 29, Ohio
Temperature and altitude cabinets

Summers Gyroscope Co., 2328 Broadway, Santa Monica, Calif.
Automatic pilots, and gyro servos

Sun Electric Corp., 6323 Avondale Ave, Chicago 31, Ill.
Electrical instruments & engine test equipment

Sun Radio & Electronics Company, 122-124 Duane St., New York 7, N. Y.
Authorized distributors for all major manufacturers of radio parts, tubes, meters, radio test equipment, electronic equipment for industrial use, instruments for laboratory and industrial tst purposes, and electronic components for the construction of such instruments

Sundstrand Machine Tool Co., 2531 11th St., Rockford, Ill.
Balancing machines, pumps, valves

**Superior Controls Co., Inc., 1835 S. Bonnie Brae, Los Angeles 6, Calif.**
Thermostats, pressure regulators, control valves
**(See advertisement on page 137)**

Superior Electric Co., 30 Harrison St., Bristol, Conn.
Industrial & laboratory apparatus

Superior Meter Co., Inc., 167 41st Street, Brooklyn, 32, N. Y.
Gas meters & appliances

**Superior Tube Co., P. O. Box 191, Norristown, Pa.**
Fine tubing
**(See advertisement on page 31)**

Supreme Instruments Corp., Greenwood, Miss.
Radio testing equipment; tube testers, set testers, analyzers, test oscillators, oscilloscopes & dynamic instruments
Gages

Surface Checking Gage Co., 1937 Taft Ave., Hollywood, 28, Calif.
Surface roughness standards and comparators

Surface Combustion Corp., 2375 Dorr Ave., Toledo 1, O.
Dew Point Recorder

Surty Mfg. Co., Inc., 4141 W. Kinzie St., Chicago 24, Ill.
Magnifiers

Suter, Alfred, 200 Fifth Ave., New York 10, N. Y.
Testing apparatus for textiles and metals

Suverkrop Instruments, Box 463, Bakersfield, Calif.
Drafting & Surveying instruments

Swartwout Co., 18511 Euclid Ave., Cleveland, Ohio
Furnace controllers

Swedish Gage Co. of America, 8900 Alpine Ave., Detroit 4, Mich.
Internal indicators; plug, ring, master disc & special built fixtures

Sylvan Electronic Labs., Broadalbin, N. Y.
Electronic instruments

Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y.
Electronic instruments

Synchro-Start Products Inc., 8151 Ridgeway St., Skokie, Ill.
Automatic starting-stopping safety controls for internal combustion engines

## T

Taber Instrument Corp., 111 Goundry St., North Tonawanda, N. Y.
Testers for measuring wear & abrasion resistance of paints, electroplate, linoleum, leather, textiles; precision stiffness gages for paper, light metallic sheet & wire

**Taco-West Corp., 525 N. Noble St., Chicago 22, Ill.**
Special electronic equipment, electronic controls and automatic machinery
**(See advertisement on page 63)**

Tagliabue Instruments Div., Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J.
Indicating, Recording and Controlling Instruments for Temperature, Pressure, Level, Flow, Humidity; Hydrometers, Chemical Thermometers. Moisture Meters for Grain, Wood, Tobacco and Granular Materials; Potentiometers, Pyrometers and Resistance Thermometers, Non-Indicating, Recording and Controlling Types; Industrial and Dial-Indicating Thermometers.

Taller & Cooper, Inc., 75 Front St., Brooklyn 1, N. Y.
Wind tunnel instruments, panel boards

Tamms Industries Inc., 228 N. LaSalle St., Chicago 1, Ill.
Pyrometers

Taylor & Co., W. A., 7300 York Road, Baltimore 4, Md.
Equipment for pH & chlorine control, control of phosphates in boiler water & for water analysis

**Taylor Instrument Cos., 95 Ames St., Rochester 11, N. Y.**
Indicating, Recording & Controlling Instruments for Temperature, Humidity, Pressure, Rate of Flow, & Liquid Level
**(See advertisement on outside front cover)**

Taylor Dynamometer & Machine Co., 528 W. Highland Ave., Milwaukee 3, Wis.
Hydraulic dynamometers, static balancing machines, super-accurate drill presses

**Technical Associates, 3730 San Fernando Rd., Glendale 4, Calif.**
Geiger-Mueller counter equipment; custom built instruments
**(See advertisement on page 97)**

Technical Products Co., 158 Madison Ave., Memphis 1, Tenn.
Laboratory supply house

Technicon Co., 215 E. 149 St., New York 51, N. Y.
Laboratory apparatus

**Techno Instrument Co., 6666 Lexington Ave., Los Angeles 38, Calif.**
Electrical and electronic instruments
**(See advertisement on page 177)**

Technology Instrument Corp., 531 Main St., Acton, Mass.
Special audio equipment

Tejax Engineering Corp., P. O. Box 1134, Providence 1, R. I.
Dial indicating handwheels, valve position indicators & V-port hand regulating valves

Tektronix, Inc., 712 S.E. Hawthorne Blvd., Portland 14, Ore.
Cathode ray oscilloscopes & video test equipment

Telechron Dept., General Electric Co., 69 Union St., Ashland, Mass.
Timers and fractional horsepower motors

Telecomputing Corp., 133 E. Santa Anita Ave., Burbank, Calif.
Automatic plotters, computers, counters, projectors

Teletronics Laboratory, 352 Maple Ave., Westbury, N. Y.
Custom design and manufacture of electronic and electro-mechanical devices

**Television Equipment Corp., 238 William St., New York 38, N. Y.**
Oscilloscopes, television cameras
**(See advertisement on page 102)**

Televiso Products Inc., 7466 Irving Park Rd., Chicago 34, Ill.
Electronic products; custom built equipment

Tempil Corp., 132 West 22 St., New York 11, N. Y.
Thermoscopic paint & thermometer sticks

**Tenney Engineering Co., 26 Ave. B., Newark 5, N. J.**
Controlled temperature, humidity and altitude test chambers and rooms
**(See advertisement on page 52)**

Testing Instruments, Inc., 242 Valley St., Dayton 4, Ohio
Electrical testing instruments for automotive equipment

Testing Machines, Inc., 123 West 64 St., New York 23, N. Y.
Physical testing machines

Testrite Instrument Co., 57 E. 11th St., New York 3, N. Y.
Scientific instruments

Thermal Syndicate Ltd., 12 East 46th St., New York 17, N. Y.
Apparatus, laboratory; flats, optical; gas & vapor discharge tubes, mercury; light sources, mercury vapor; light sources; ultra-violet; optical parts

**Thermo-Electric Co., 22-02 Raphael St., Fair Lawn, N. J.**
Thermocouples for aircraft engines & industrial uses, extension lead wires & harnesses
**(See advertisement on page 134)**

Thermo Electric Manufacturing Co., 480 W. Locust St., Dubuque, Iowa
Laboratory furnaces
Thermo Instruments Co., Box 336, Belmont, Calif.
Industrial instruments

Thomas Clock Co., Seth, Industrial Sales Dept., Thomaston, Conn.
Household clocks, outdoor & tower clocks, clock movements for industrial purposes, also electric timers

Thomas Co., Arthur, H., West Washington Square, Philadelphia 5, Pa.
Dealers, retail-wholesale-export, in laboratory apparatus & reagents for laboratories of chemistry & biology

Thomas & Skinner Steel Products Co., 1118 E. 23rd St., Indianapolis, Ind.
Permanent magnets

Thompson Balance Co., 802 E. 18 Ave., Denver 5, Colo.
Fine balances & weights

Thompson Clock Co., H. C., Bristol, Conn.
Electric stop clocks & interval timers

Thordarson Elec. Mfg. Div., Maguire Industries, Inc., 500 W. Huron St., Chicago 10, Ill.
Transformers

Thwing-Albert Instrument Co., 5323 Pulaski Ave., Philadelphia 44, Pa.
Pyrometers, paper testing instruments, portable pH meters, general testing instruments & machines

Times Facsimile Corp., 540 West 58 St., New York 19, N. Y.
High Speed recording and communications equipment

**Tinsley Laboratories, Inc., 2526 Grove St., Berkeley 4, Calif.**
Astronomical instruments, optical instruments
**(See advertisement on page 98)**

Tobe Deutschmann Corp., Norwood, Mass.
Electrical and electronic instruments

Toledo Scale Co., 1074 Telegraph Rd., Toledo, Ohio
Automatic Scale for weighing, counting, check-weighing, compounding, force-measuring, weight-printing & weight-recording; & special devices for testing, classifying & standardizing

Topflight Tape Co., 116 E. Market St., York, Pa.
Printed pressure-sensitive tape for identification and labeling

Tork Clock Co., Inc., 1 Grove St., Mt. Vernon, N. Y.
Clocks, timers, time controllers

**Tracerlab, Inc., 130 High St., Boston, Mass.**
Radioactivity detectors, continuous thickness gages, nucleonics instrumentation, isotopes
**(See advertisement on page 24)**

Transicoil Corp., 107 Grand St., New York 13, N. Y.
Servo motors

Transvision, Inc., 460 North Ave., New Rochelle, N. Y.
Soldering irons

Trans-Sonics, Inc., Bedford Airport, Bedford, Mass.
Airbourne instrumentation

Trenton Transformer Corp., P. O. Box 568, Trenton, N. J.
Instrument, regulating and testing transformers, magnetic components

Trerice Co., H. O., 1420 Lafayette Blvd., W., Detroit 16, Mich.
Industrial instruments

**Trimount Instrument Company, 3119-21 West Lake St., Chicago 12, Ill.**
Manometers: well type, sliding scale U-tube, fixed scale U-tube, inclined, absolute pressure, & service; gages: draft & mercury pressure; indicating flow meters & tank level indicators
**(See advertisement on page 88)**

Triner Sales and Service Co., 325 W. Huron St., Chicago 10, Ill.
Scales and service

**Trinity Equipment Corp., 472 Westfield Ave., East, Roselle Park, N. J.**
Thermocouple wells; thermometer test wells; separable sockets for thermometers; drilled, welded and cast protecting tubes; stainless steel laboratory apparatus; special alloy machine products; deep hole drilling of alloy bars; API-ASME code alloy welding and fabrication
**(See advertisement on page 139)**

**Triplett Electrical Instrument Co., Harmon Avenue, Bluffton, Ohio**
Electrical measuring instruments & radio testing equipment. Also instruments for laboratory and industrial test purposes; switches, relays, resistors, shunts
**(See advertisement on page 42)**

Triumph Mfg. Co., 913 W. Van Buren St., Chicago 7, Ill.
Radio test instruments

Troemner, Henry, 911 Arch St., Philadelphia 7, Pa.
Balances

**Turner Electric Co., E. W., 6138-40 N. Beechwood St., Philadelphia 38, Pa.**
Thermowells
**(See advertisements on pages 101, 138)**

# ANNOUNCEMENT

Early this year we announced acquisition of the Western Electric MIRRAGRAPH business. We have recently taken over the remainder of the Western Electric industrial instrument line and are now in production on 3-A Analyzers, 4-A Graphic Recorders, 701-A Sound Level Meters, and 731-A Filter Sets. Prices and delivery on request.

We also produce custom-built Multi-Channel Recording and Analyzing Systems and Automatic Transmission Measuring Systems covering a wide range of frequencies, as well as Curve Followers, Graph Readers, and Regulated Power Supply Units to meet particular requirements. Write us concerning your problems.

Licensed under all Western Electric Patents
in the Testing and Measuring Field

Techno Instrument Company
6666 LEXINGTON AVENUE
LOS ANGELES 38, CALIFORNIA
TELEPHONE
GLADSTONE 3304

## U

U C Indicator Co., 624 E. Locust St., Milwaukee 12, Wis.
Liquid level gages

**Uehling Instrument Co., 473 Getty Ave., Paterson 3, N. J.**
$Co_2$ recorders, vacuum recorders, absolute pressure recorders, draft recorders, combined pressure & vacuum recorders, liquid level gages, pressure & vacuum gages, inclined draft gages, well-type direct reading manometers, U-tube manometers, absolute pressure gages
**(See advertisement on page 78)**

Uhrig Co., Joseph F., 4101-03 North 5 St., Philadelphia 40, Pa.
Scientific glassware

**Ulanet Co., George, 413-15 Market St., Newark 5, N. J.**
Thermostats
**(See advertisement on page 140)**

Ulmer Co., J. C., 1791 E. 38th St., Cleveland 14, Ohio
Surveying instruments

**Ultrasonic Engineering Co., 1613 S. 3 Ave., Maywood, Ill.**
Ultrasonic generators and transducers, photoelectric photometers
**(See advertisements on pages 82, 103)**

Ultra-Violet Products, Inc., 145 Pasadena Ave., South Pasadena, Calif.
Fluorescence and ultra-violet lamps

**Unertl Optical Co., John, 3551-3555 East St., Pittsburgh 14, Pa.**
Optical instruments
**(See advertisement on page 98)**

Ungar Electric Tool Co., Inc., 611-15 Ducommun St., Los Angeles 54, Calif.
Electric soldering irons

**Uniform Tubes, Level Road, Collegeville 2, Pa.**
Precision tubes of all metals
**(See advertisement on page 144)**

Unimax Switch Corp., 460 West 34 St., New York 1, N. Y.
Switches

United Condenser Corp., 337 E. 139 St., New York 54, N. Y.
Capacitors

United Electric Controls Co., 85 School St., Watertown

United Electronics Co., 42 Spring St., Newark 2, N. J.
Vacuum capacitors and vacuum tubes

United States Blue Print Paper Co., 207 S. Wabash Ave., Chicago 4, Ill.
Surveying instruments

**United States Gauge Div., American Machine & Metals, Sellersville, Pa.**
Indicating & recording pressure gages
**(See advertisement on page 39)**

United States Instrument Corp., 409 Broad St., Summit, N. Y.
Voice powered telephone equipment

United States Taximeter Co., Div. of Weisinger Recording Instruments Corp., 503 W. 54th St., New York 19, N. Y.
Speedometers, tachometers, taxi meters

United States Radium Corp., 535 Pearl St., New York 7, N. Y.

Radioactive products, fluorescent materials, screens and dials, standards of radioactivity
72, Mass.

United Transformer Corp., 150 Varick St., New York 13, N. Y.
Transformers

Universal Drafting Machine Co., 7960 Lorain Ave., Cleveland, Ohio
Drafting Machines

Universal X-Ray Products, 1140 Western Ave., Chicago 22, Ill.
Barometers, manometers, vacuum gages, X-ray equipment

Univis Lens Company, 401 Leo St., Dayton 1, Ohio
Optical flats, lenses & prisms

# V

Vacutron, Inc., 2819 12th St., So., Arlington, Va.
Special vacuum tubes; electronic circuits & industrial control devices

Vacuum Electronics Engg. Co., 756 Third Ave., Brooklyn 32, N. Y.
Leak detectors

Valpey Crystals, 1244 Highland St., Holliston, Mass.
Quartz crystals for frequency control

Valvair Corp., 454 Morgan Ave., Akron 11, Ohio
Control valves

Valve Pilot Corp., 230 Park Ave., New York 17, N. Y.
Locomotive speed indicator & recorder and locomotive speed & cut-off indicator & recorder

Valverde Labs., 252 Lafayette St., New York 12, N. Y.
Thermal controls

Van Dyke Instruments, Inc., 1927 First Ave., St. Petersburg, Fla.
Accelerometers, remote-metering equipment, resistors

Van Keuren Co., 176 Waltham St., Watertown, Mass.
Optical comparators & flats

Van Wagner Co., 89-04 113 St., Richmond Hill 18, N. Y.
Inspection devices

**Vapor Recovery Systems Co., Box 231, Compton, Calif.**
Liquid level gages, manometers, remote metering equipment and control valves
**(See advertisement on page 77)**

Varian Associates, 99 Washington St., San Carlos, Calif.
Klystrons; nuclear resonance spectrometers; traveling-wave tubes; amplifiers; fluxmeters; electronic components

Varo Mfg. Co., Box 638, Garland, Texas
Electronic instruments

**V & E Manufacturing Co., 789 S. Arroyo Parkway, Pasadena, Calif.**
Drafting machines; drafting room instruments
**(See advertisement on page 66)**

Vectron Inc., 235 High St., Waltham, Mass.
Optical and electronic instruments, automatic control systems; aircraft instruments

Veeder-Root, Inc., 28 Sargent St., Hartford 2, Conn.
Electrically operated counting devices, a.c. and d.c.

Vibration Specialty Co., 1536 Vine St., Philadelphia, Pa.
Vibration and acceleration indicating and recording instruments

Vickers Electric Div., Vickers Inc., 1815 Locust St. St. Louis 3, Mo.
Rectifiers and photoelectric cells

Vickers, Inc., 1400 Oakman Blvd., Detroit 32, Mich.
Pumps & valving devices for control of power in oil-hydraulic systems

Victoreen Instrument Co., 5806 Hough Ave., Cleveland 3, Ohio
Electrometers, spectrometers, vacuum tubes

Victory Engineering Corp., 744 Broad St., Newark, N. J.
Analyzing, detecting and automatic control instruments

Viking Instruments Inc., East Haddam, Conn.
Tachometers

Vinco Corp., 9111 Schaefer Highway, Detroit 28, Mich.
Special gages

Visco-Meter Corp., 315 Grote St., Buffalo 7, N. Y.
Viscosimeter

Voland & Sons, Inc., New Rochelle, N. Y.
Analytical balances & weights
Communication measuring instruments

# W

Wabash Metal Products Co., Hydraulics Div., 1569 Morris St., Wabash, Ind.
Laboratory presses

Wagner & Son, Carl H., 1944 N. Albany Ave., Chicago 47, Ill.
Thermometers

Walker & Co., Geo. T., 324 Fifth Ave., South, Minneapolis 15, Minn.
Laboratory supplies

Walker-Jamieson, Inc., 311 S. Western Ave., Chicago 12, Ill.
Radio & electronic supplies

Walkirt Co., 5808 Marilyn Ave., Culver City, Calif.
Counters; monitors; testers; scalers

**Wallace & Tiernan Products, Inc., 1 Main St., Belleville 9, N. J.**
Chlorine control & chemical feed devices, meteorological instruments
**(See advertisements on pages 45, 74, 79, 89, 147)**

Walser Automatic Timer Corp., 420 Lexington Ave., New York 17, N. Y.
Timers

Waltham Watch Co., Waltham, Mass.
Stop watches

Ward Leonard Electric Co., 115 Mac Questen Parkway South, Mount Vernon, N. Y.
Resistors, rheostats, relays, motor starters, speed controllers, voltage regulators, electric control devices

Warner & Swasey Co., 5701 Carnegie Ave., Cleveland 3, Ohio
Telescopes

Warren-Knight Co., 136 N. 12th St., Philadelphia 7, Pa.
Surveying instruments & equipment

**Warrick Co., Charles F., 1964 West 11 Mile Rd., Berkley, Mich.**
Scientific cameras
**(See advertisement on page 61)**

Warrick, Frederick P., 1960 Graefield St., Birmingham, Mich.
Relays & auxiliary equipment for level controls

Water Leak Detector Co., 114 N. Third St., Columbus 15, Ohio
Water leak detectors

Water Level Controls Div., Healy-Ruff Co., 2255 University Ave., St. Paul 4, Minn.
Liquid level controls

Waterman Engineering Co., 721 Custer Ave., Evanston, Ill.
Automatic flow controllers

**Waterman Products Co., Inc., 2445 Emerald St., Philadelphia 25, Pa.**
Portable oscillographs
**(See advertisement on page 32)**

Weatherhead Co., 300 East 131 St., Cleveland 8, Ohio
Pneumatic and hydraulic hose, cocks and fittings

Webber Gage Co., 12904 Triskett Rd., Cleveland 11, Ohio
Gage blocks

Weber Bros. Metal Works, 108 N. Jefferson St., Chicago 6, Ill.
Laboratory apparatus

Weber & Co., F., 1220 Buttonwood St., Philadelphia 23, Pa.
Mathematical & surveying instruments

Webster Instrument Co., 11856 Mississippi Ave., Los Angeles 25, Calif.
Hardness testers, especially for non-ferrous alloys

Weiler, Paul G., 95 Broad St., New York 4, N. Y.
Resistance thermometers

**Weksler Thermometer Corp., 52-56 West Houston St., New York 12, N. Y.**
Thermometers, hydrometers, psychrometers
**(See advertisement on page 136)**

**Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.**
Electrical instruments, vacuum pumps & items for science laboratories
**(See advertisement on page 147)**

West Coast Electronics Co., 1601 S. Burlington St., Los Angeles 6, Calif.

West & Dodge Thread Gauge Co., Inc., 6 Power House St., South Boston, Mass.
Screw thread gages

**Westberg Mfg. Co., 6535 N. Olmsted Ave., Chicago 31, Ill.**
Automotive service instruments, flowmeters, tachometers
**(See advertisement on page 124)**

Western Radiation Lab., 1107 W. 24 St., Los Angeles 7, Calif.
Radioactivity detecting and measuring instruments; meg-megohmmeters; electron tubes

Westinghouse Electric Corp., 306 4th Ave., P. O. Box 1017, Pittsburgh 30, Pa.
Switchboard, panel & portable measuring instruments, aircraft instruments, recorders, industrial & radio test set equipment.

Westinghouse X-Ray Co. Inc., 2519 Wilkins Ave., Baltimore 3, Md.
Industrial X-Ray equipment

**Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J.**
Switchboard, panel & portable measuring instruments. Industrial & radio test equipment.
Light measuring instruments and photographic exposure meters. Also dial type industrial temperature gages, control relays and aircraft instruments.
**(See advertisement on page 7)**

Wheaton Co., T. C. Millville, N. J.
Glassware

Wheatstone Corp., 2436 Reading Rd., Cincinnati 2, Ohio
Thermocouples & pyrometer tubes

**Wheelco Instruments Co., 847 W. Harrison St., Chicago, Ill.**
Temperature, indicating, recording & control instruments, temperature limit & shut-off device; automatic combustion safeguards
**(See advertisements on pages 56, 58, 110)**

White Co., Inc., David, 315 W. Court St., Milwaukee 12, Wis.
Surveying instruments

White-Rodgers Electric Co., 1209 Cass Ave., St. Louis 6, Mo.
Furnace controls

Wiancko Engr. Co., 2670 N. Fair Oaks Ave., Altadena, Calif.
Airborne and ground station instruments; fire-control instruments; test stands and devices

Wilcolator Co., 1001 Newark Ave., Elizabeth 8, N. J.
Thermostats

Wilder Inc., R. S., 26 Bedford St., Waltham, Mass.
Microprojector

Wilkening Mfg. Co., 1998 S. 71st St., Philadelphia 42, Pa.
Piston ring gages

Wilkens-Anderson Co., 4525 W. Division St., Chicago 51, Ill.
Laboratory supplies

Will Corp., 39 Russell St., Rochester 3, N. Y.
Laboratory supplies & apparatus

Williams Apparatus Co., Inc., Herald Bldg., Watertown, N. Y.
Pulp & paper testing equipment & flue gas analysis apparatus

Williams, Brown & Earle, Inc., 918 Chesnut St., Philadelphia 7, Pa.
Laboratory supplies

Williams Gauge Co. 1620 Pennsylvania Ave., Pittsburgh 12, Pa.
Water level gages

Willson Products, Inc., Reading, Penna.
Anemometers

Wilmotte, Inc., Raymond M., 1469 Church St., N. W., Washington, D. C.
Electronic gaging instruments

Wilson & Co., G. C., 2 N. Passaic Ave., Chatham, N. J.
Remote-control and remote-metering equipment

Wilson Mechanical Instrument Co., Inc., 230 Park Ave., New York 17, N. Y.
Hardness testers

Winchester Electronics Co., 6 E. 46th St., New York 17, N. Y.
Connectors, plugs, clips, posts, jacks

Winslow Co., Inc., 9 Liberty St., Newark 5, N. J.
Ignition hardness test sets, aircraft engine instruments, thermocouples & instrument accessories, tachometers, vacuum gages, radio & telegraph keys, molded rubber cord sets, megohmeters, Wheatstone bridges

Wollensak Optical Co., 880 Hudson Ave., Rochester 5, N. Y.
Optical instruments

Wood Counterlab, N., 5646 Harper Ave., Chicago 37, Ill.
Radiation detecting and measuring instruments

Woods "Lab. Apparatus", F. W., 140-6 Warden St., Pittsburgh 20, Pa.
Biological laboratory supplies

**Woods Hole Oceanographic Inst., Woods Hole, Mass.**
Oceanographic instruments

**Woodworth Co., N. A., 1300 East 9 Mile Rd., Detroit, Mich.**
Gages for physical measurements

**Worley Jewel Co., John, Waltham, Mass.**
Jewels & pivots

**Worner Electronic Devices, Rankin, Ill.**
Photoelectric products

**Worthington Pump & Machinery Corp., Harrison, N. J.**
Liquid meters and instrument air compressors

**Wroble Engineering Co., 1067 Davis Terrace, Schenectady 3, N. Y.**
Universal testing machines

**Wyland, George C., Center St., Ramsey, N. J.**
X-Ray tubes & cameras

## Y

**Yardeny Engineering Co., 105-107 Chambers St., New York 1, N. Y.**
Remote control systems

**Yarnall-Waring Company, 102 E. Mermaid Lane, Chestnut Hill, Philadelphia 18, Pa.**
Water columns, water gages & blow-off valves for steam boilers, spray nozzles for liquids & hydraulic valves for presses

**Yellow Springs Instrument Co., Inc., Box 211, Yellow Springs, Ohio**
Construction of special instruments

**Yoder Company 5500 Walworth Ave., Cleveland, Ohio**
Cement testers

**Yonkers Lab. Supply Co., 252 Hawthorne Ave., Yonkers 5, N. Y.**
Laboratory supplies

**York Ice Machinery Corp., York, Pa.**
High altitude test & calibration chambers

## Z

**Zeiss, Inc., Carl, 485 Fifth Ave., New York 17, N. Y.**
Optical instruments
**(See advertisement on page 93)**

**Zenith Optical Co., Huntington 19, W. Va.**
Microscopes, lenses, optical flats

**Zenith Optical Laboratory, 1940 Great Neck Rd., Capiague, L. I., N. Y.**
Lenses, mirrors

**Zernickow Co., O., 15 Park Row, New York 7, N. Y.**
Tachometers, tachographs, tachoscopes, cutmeters, stop watches

# The man who KNOWS—Knows where to LOOK

**And a more complete personal or company library assures easy accessibility to reference sources which can enhance your knowledge. Each of the books listed below is a "must" for the instrumentation library.**

**Mechanical Measurements by Electrical Methods** *by* HOWARD C. ROBERTS, Second Edition, 1951, cloth, 4¾" x 8¼", 357 pages. *Price* $4.00.

**Maintenance and Servicing of Electrical Instruments** *by* JAMES SPENCER, Third Edition, 1951, cloth, 4¾" x 8¼", 256 pages. *Price* $3.00.

**Instrumentation for the Process Industries** (Proceedings Fifth Annual Symposium on Instrumentation for the Process Industries, School of Engineering, Agricultural and Mechanical College of Texas,) 1951, paper, 8" x 11¼", 56 pages. *Price* $2.50.

**A Romance in Research**—The Life of C. F. Burgess *by* A. M. MCQUEEN with Technical Appendix *by* O. W. STOREY, 1951, cloth, 6" x 9", 430 pages. *Price* $6.00.

**Applications of Industrial pH Controls** *by* ALLEN L. CHAPLIN, 1950, cloth, 4½" x 8", 144 pages. *Price* $2.50.

**Heat Inertia in Problems of Automatic Control of Temperature** *by* VICTOR BROIDA, 1950, paper, 5¼" x 8¼", 61 pages. *Price* $1.00.

**Operation and Care of Circular-scale Instruments** *by* JAMES SPENCER, 1949, cloth, 4½" x 8", 90 pages. *Price* $1.50.

**Scientific and Industrial Glass Blowing and Laboratory Techniques** *by* W. E. BARR and VICTOR J. ANHORN, 1949, cloth, 4½" x 8", 388 pages. *Price* $6.00.

**Elementary Engineering Electronics** *by* ANDREW W. KRAMER, 1945, cloth, 4½" x 8", 340 pages. *Price* $2.00.

**The Engine Indicator**—Its Design, Theory and Special Applications *by* K. J. DEJUHASZ, 1934, cloth, 5½" x 8¼", 243 pages. *Price* 2.00.

Payment must accompany orders. Send orders to BOOK DEPARTMENT.

**INSTRUMENTS PUBLISHING CO.**
**921 Ridge Ave., Pittsburgh 12, Pa.**

# WHAT PRICE PERFECTION!

**"PERFECTION" is the most important word in the entire English language to a group of men at John Chatillon & Sons.**

These researchers, engineers and planners are constantly working toward the improvement of measuring apparatus that already connotes perfection to every user

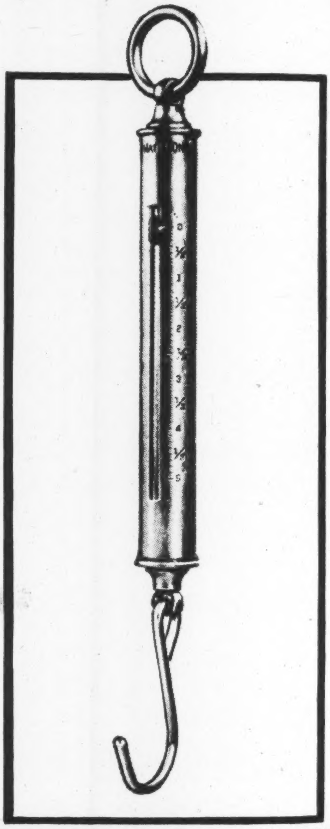
For example: These Force Measuring Devices, which are the finest available, are individually calibrated and guaranteed to be accurate within one graduation mark on the gauge. This exactness is universally accepted, inasmuch as such devices simply are not expected to be more accurate. But — to John Chatillon & Sons, it represents a challenge—and full time research is constantly going on, until "Perfection"—complete and ultimate, is achieved.

**"Resting on Laurels" is an invalid phrase at Chatillon.**

## CHATILLON SPECIAL
## FORCE MEASURING DEVICES

*Only one fine Chatillon Device from Our Complete Line*

- For adjusting Spring Tension of D.C. Motor Brush Holder
- For use with Torque Measuring Devices
- For Measuring Force in All Phases of Industrial & Laboratory Work



## JOHN CHATILLON & SONS

**will design and manufacture Scales and other Measuring Devices to Meet Your Particular Needs.**

**FILL IN AND MAIL COUPON TODAY**

**John Chatillon & Sons, 85 Cliff Street, New York 7, N. Y.**

Gentlemen: Please send me brochures and price information on

☐ Force Measuring Devices ☐ Traction Dynamometers
☐ Push Pull Gauges ☐ Laboratory Scales

Name.............................................. Company..............................
Address........................................... Position Held.........................

## JOHN CHATILLON & SONS

**85 Cliff Street, Dept. 17**
**New York 7, N. Y**

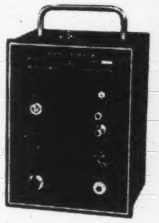
*Manufacturers and Designers of Precision Instruments Since 1835*

# MEASUREMENTS CORPORATION

## *Laboratory Standards*

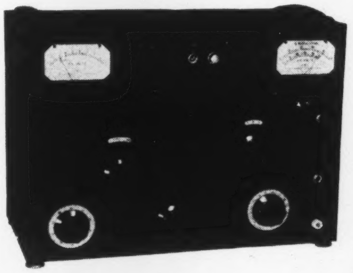
QUALITY ELECTRONIC
MEASURING INSTRUMENTS
FOR ACCURATE, DEPENDABLE SERVICE

**NEW!**



**CRYSTAL CALIBRATOR**
*Model 111*
250 Kc. to 1000 Mc.

**INTERMODULATION METER**
*Model 31*
Range: 0 to 30%



**STANDARD SIGNAL GENERATOR**
*Model 82*
20 Cycles to 50 Mc.

**MEGACYCLE METER**
*Model 59*
2.2 Mc. to 400 Mc.

### STANDARD SIGNAL GENERATORS

| MODEL | FREQUENCY RANGE | OUTPUT RANGE | MODULATION |
|---|---|---|---|
| 65-B | 75 Kc.-30 Mc. | 0.1 microvolt to 2.2 volts | AM. 0 to 100%<br>400 cycles or 1000 cycles<br>External mod., 50-10,000 cycles |
| 78 | 15-25 Mc.; 195-225 Mc.<br>15-25 Mc.; 90-125 Mc.<br>other ranges on order | 1 to 100,000 microvolts | AM. 8200-400 cycles<br>625-400 cycles<br>Fixed at approximately 30% |
| 78-FM | 86 Mc.-108 Mc. | 1 to 100,000 microvolts | Deviation 0-300 kc, 2 ranges<br>FM. 400-8200 cycles<br>External modulation to 15 Kc. |
| 80 | 2 Mc.-400 Mc. | 0.1 to 100,000 microvolts | AM. 0 to 30%<br>400 cycles or 1000 cycles<br>External mod., 50-10,000 cycles. |
| 82 | 20 cycles to 200 Kc.<br>80 Kc. to 50 Mc. | 0-50 volts<br>0.1 microvolt to 1 volt | Continuously variable 0-50% from 20 cycles to 20 Kc. |
| 84 | 300 Mc.-1000 Mc. | 0.1 to 100,000 microvolts | AM. 0 to 30%, 400, 1000, or 2500 cycles. Internal pulse modulator. External mod., 50-30,000 cycles. |
| 90 | 20 Mc.-250 Mc. | 0.3 microvolt to 0.1 volt | Continuously variable, 0 to 100% Sinusoidal modulation 30 cycles-5 Mc. Composite TV modulation. |

### U.H.F. OSCILLATOR

| MODEL | FREQUENCY RANGE | OUTPUT RANGE | OUTPUT IMPEDANCE |
|---|---|---|---|
| 112 | 300 Mc. — 1000 Mc. | Maximum varies between 0.3 volt and 2 volts. Adjustable over 40 db range | 50 ohms |

### PULSE GENERATOR

| MODEL | FREQUENCY RANGE | PULSE WIDTH | OUTPUT |
|---|---|---|---|
| 79-B | 60 to 100,000 cycles | Continuously variable from 0.5 to 40 microseconds | Approximately 150 volts positive with respect to ground. "Sync Output" 75 volts positive with respect to ground. |

### SQUARE WAVE GENERATOR

| MODEL | FREQUENCY RANGE | WAVE SHAPE | OUTPUT |
|---|---|---|---|
| 71 | Continuously variable 6 to 100,000 cycles | Rise time less than 0.2 microseconds with negligible overshoot | Step attenuator: 75, 50, 25, 15, 10, 5 peak volts fixed and 0 to 2.5 volts continuously variable. |

### U.H.F. RADIO NOISE and FIELD STRENGTH METER

| MODEL | FREQUENCY RANGE | INPUT VOLTAGE RANGE |
|---|---|---|
| 58 | 15 Mc. to 150 Mc. | 1 to 100,000 microvolts in antenna. 1 to 100 microvolts on semi-logarithmic output meter, balanced resistance attenuator with ratios of 10, 100 and 1000 ahead of all tubes. |

### VACUUM TUBE VOLTMETERS

| MODEL | VOLTAGE RANGE | FREQUENCY RANGE | INPUT IMPEDANCE |
|---|---|---|---|
| 62 | 0-1, 0-3, 0-30 and 0-100 volts AC or DC | 30 cycles to over 150 Mc. | Approximately 7 mmfd. |
| 62-U.H.F. | 0-1, 0-3, 0-30 and 0-100 volts AC or DC | 100 Kc. to 500 Mc. | Approximately 2 mmfd. |
| 67 | .0005 to 300 volts peak-to-peak | 5 to 100,000 sine-wave cycles per second | 1 megohm shunted by 30 mmfd. |

### MEGACYCLE METER

| MODEL | FREQUENCY RANGE | FREQUENCY ACCURACY | MODULATION |
|---|---|---|---|
| 59 | 2.2 Mc. — 400 Mc. | Within ±2% | CW or 120 cycles fixed at approximately 30%. Provision for external modulation |

### CRYSTAL CALIBRATOR

| MODEL | FREQUENCY RANGE | FREQUENCY ACCURACY | HARMONIC RANGE |
|---|---|---|---|
| 111 | 250 Kc. — 1000 Mc. | 0.001% | .25 Mc. Oscillator: .25-450 Mc.<br>1 Mc. Oscillator: 1-600 Mc.<br>10 Mc. Oscillator: 10-1000 Mc. |

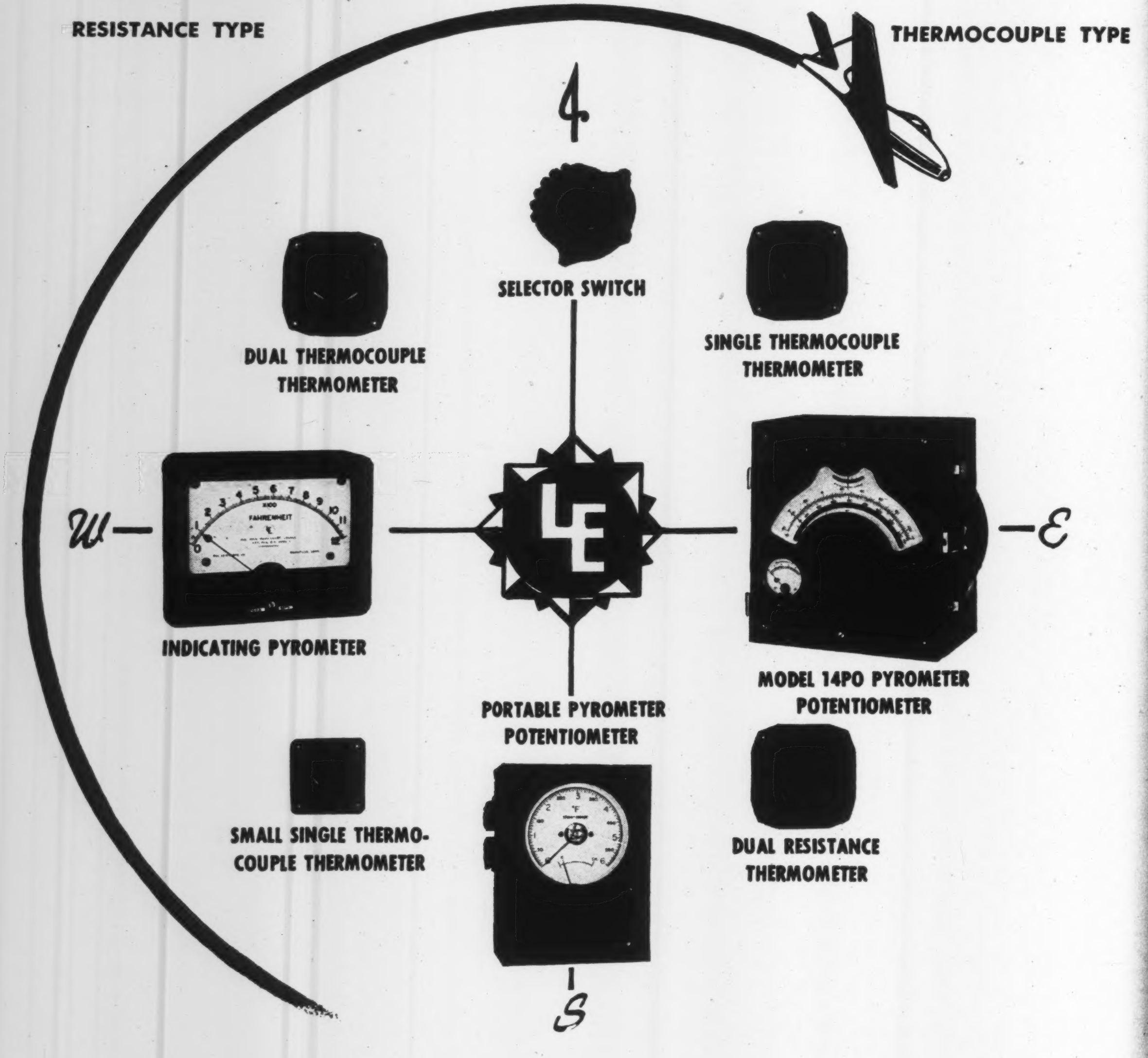
### BRIDGES

| MODEL | INDUCTANCE (L) | CAPACITANCE (C) | AC RESISTANCE (R) |
|---|---|---|---|
| 102 | 0.5 microhenry to 110 henries | 1 mmf. to 110 mfd. Power factor 0-30% | 1 ohm to 11 megohms |

**MEASUREMENTS CORPORATION • BOONTON, N. J.**

LEWIS

# COMPLETE TEMPERATURE INDICATING SYSTEMS


RESISTANCE TYPE
THERMOCOUPLE TYPE
N
SELECTOR SWITCH
DUAL THERMOCOUPLE THERMOMETER
SINGLE THERMOCOUPLE THERMOMETER
W
LE
E
INDICATING PYROMETER
MODEL 14PO PYROMETER POTENTIOMETER
PORTABLE PYROMETER POTENTIOMETER
SMALL SINGLE THERMOCOUPLE THERMOMETER
DUAL RESISTANCE THERMOMETER
S

For complete standardized systems, use LEWIS components throughout . . . thermocouples, leads, connector blocks, firewall blocks, lead resistors and thermocouple temperature indicators, or . . . resistance bulbs and electrical resistance thermometers . . . two temperature measuring systems, each with its own functional advantages . . . both made by a pioneer manufacturer of aircraft temperature indicators.

## THE LEWIS ENGINEERING CO.

**Specialists in Electrical Temperature Measurements**

NAUGATUCK, CONNECTICUT

E

S